Bike Rack only. —MC

09/03/16 - TCCA Flight test review
08/04/16 - Remove EC130 B4 to move ahead w/ AS350
CP Revised
11/04/16 - CR/TR submitted for acceptance Bike Rack
13/04/16 - Request for acceptance
18/04/16 - Status request / FT scheduling
19/04/16 - loads / test plan accepted
29/04/16 - Revised CP submitted

03/05/16 - ICA FOC / Acceptance ~~by~~ in CP clarified
26/05/16 - Revised CP submitted, Flight Testing Prep.
30/05/16 - Conformity inspections before FT
Request to move conformity
13/06/16 - ~~Final~~ dwgs before cert FT
- Final dwgs submitted
14/06/16 - Company FT docs submitted
15/06/16 - Certification FT
21/06/16 - Conformity inspection
22/06/16 - updated install dwg submitted
23/06/16 - Conformity observations provided
30/06/16 - updated dwgs to address conformity observations

14/07/16 - Status request re conformity / FT / ICA
Malik did not know he had to review?
↳ updated report 18/07/16
19/07/16 ICA submitted →
20/07/16 - Answered questions / update inst dwg.
25/07/16 - Status request
28/07/16 - "Apart from ICA review, no other concerns"

Malik → out of office auto response 26/07/2016 → 04/08/2016
04/08/2016 → 15/08/2016

27/04/15 - Application for EC130 Bike rack / basket - Jack
17/05/15 - Separate application for Bike racks . Jack
15/05/15 - Application / Intro to Pacific office Rob Metz, Michael
21/05/15 - M.C. assigned as Aero OPI
27/05/15 - Corrected application submitted Michael
28/05/15 - " M.C.
01/06/15 - Application for EC130 Basket resubmitted JS
03/06/15 - Questions from JS on EC130 JS
04/06/15 - " JS

16/10/15 - Reports / dwgs submitted for Review "No Napnopan JS
16/10/15 - " " " " " MC → "next week"
26/10/15 - Status request - No response JS/MC
02/11/15 - Status request → JS "~~Margot~~ got file from clerk"
20/11/15 - Status request - no response

01/12/15 - EC130 Questions JS
01/12/15 - Status update - MC - no response
07/12/15 - status update - MC / RM "busy on higher priority tasks"
07/12/15 - Status update - JS
11/12/15 - update bike rack to external load, not cargo compart MC
Responded by JC
17/12/15 - Basket drag - JS JS
20/01/16 - Basket drag - JS
16/02/16 - Revised CP sent to MC / JS
22/02/16 - Status ~~update~~ request MC → "Next week"

02/03/16 - Status request JS / MC
04/03/16 - " JS / MC → MC CP accepted
07/03/16 - " JS
08/03/16 - JS advised retirement → No accepted CP etc.
transfered to Vancouver
14/03/16 - Status request MC

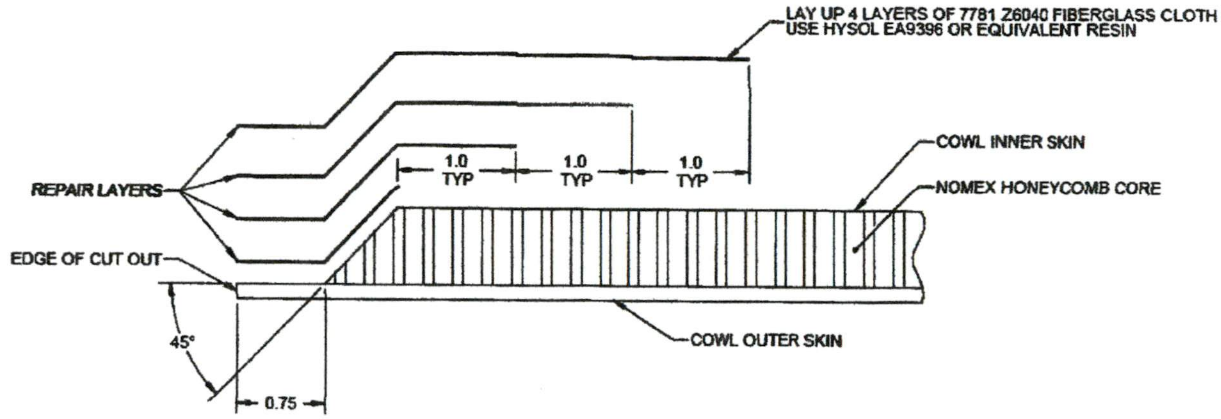


Figure 12 – Cowl Cutout Repair Detail (-043 Baskets)

Note: Composite repair to be accomplished in accordance with Airbus EC 130 Standard Practices Section 20.03.07.101

metal screens. The appropriate value of the $C_{D,\text{mesh}}/\phi$ ratio is chosen, which determines, from the $\beta = 0°$ intercept, the necessary yaw curve. In the absence of further data, Fig. 3.24b may be used for all sharp-edged meshes.

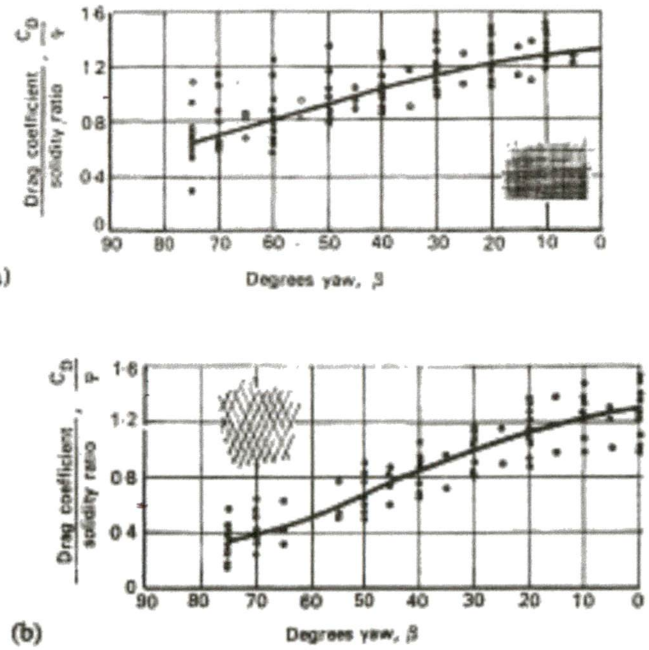


FIG. 3.24. Drag coefficients for two types of screens.[43] (a) Wire-mesh screens. (b) Expanded metal screens.

3.6. Moments

The variation in pressure on the surface of a structure inclined to the wind stream results in a moment on the structure. For rotating structures, such as radar aerials, the moment is the most important wind effect, but it can also have considerable influence on other structures. Torsion is produced in thin, tall buildings, oscillations are set up in cranes, and communications masts are twisted out of line.

When the structure is static or slow moving, the moments may be simulated by static model tests in a wind-tunnel. If, however, the structure is rotating, there is an additional moment which is added to, and can double, the static one. For bluff bodies (non-aerodynamic), this extra moment can be calculated by a quasi-static analysis. Static moments are caused by one or more of three effects. For a mesh plate, with a uniform pressure distribution, a central axis will produce no moment around it. Setting the axis forward or back does, however, produce a moment caused by unequal wind areas about the axis (Fig. 3.25a, b). This type is therefore called Area Moment. When the structural surface is solid, the pressure distribution is unequal on either side of the centre-line for angles of yaw (Fig. 3.25c), and there will be a moment at all yaw angles other than 0° or 180°, whatever the position of the axis. This type of moment is called Pressure Moment. By using a combination of area and pressure moments, the moment at any particular yaw angle may be cancelled out, but may result in an increase at other angles (Fig. 3.25d). Structures with an aerodynamic profile at some yaw attitudes, like a

Sun 6 hrs draft
990 cutouts

Sat 2-hr eng.
Fri - 4 hr compliance plan

Hoerner Ch. 3 Section 9 - Drag of non solid bodies

Sharp edge strips

σ = solidity ration
$= 0.26$

Same as Sachs →

$$\xi_{sharp} = (0.5 + \sigma)^2 / (1 - \sigma)^2$$
$$= (0.5 + 0.26)^2 / 1 - 0.26)^2$$
$$= 0.5776 / 0.5476$$
$$= 1.05$$

flow constricts to $\approx 2/3$ open area

Free flow Principle
- smaller solidity ratios

$$\xi_{free} = C_{D_0}\,\sigma / (1-\sigma)^2$$
$$= 2 \times 0.26 / (0.74)^2$$
$$= 0.95$$

$C_{D_0} = 2.0$ for rectangular box

(seems to correspond to fig 43)

$$C_{D\square} = 1 - ((4-\xi)/(4+\xi))^2$$
$$= 1 - (3.05/4.95)^2$$
$$= 1 - 0.38$$
$$= 0.62$$

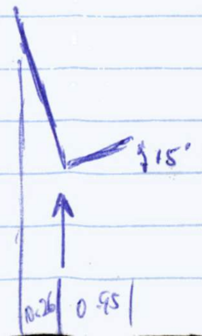
Very close to Sachs 0.63

$\xi = 1.0 / C_{D\square} = 0.6$

Beyond this $C_{D\square}$ steadily approaches the value of a solid plate or disc

Perpendicular to airflow → front area only
to V_{NE} <u>not</u> V_D
original calc conservative ($C_D = 1.1$ check)

Yaw @ 15° @ V_{NE}



Hilary

WIND FORCES IN ENGINEERING

2nd Edition

Peter Sachs, M.A., C. Eng., M.I. Mech.E.

Pergamon Press

WIND FORCES IN ENGINEERING

BY

PETER SACHS M.A., C.Eng., M.I.Mech.E.

SECOND EDITION

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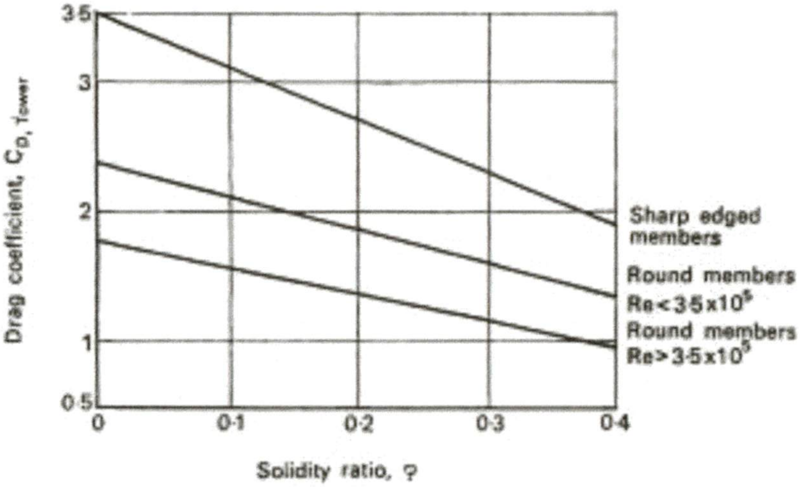


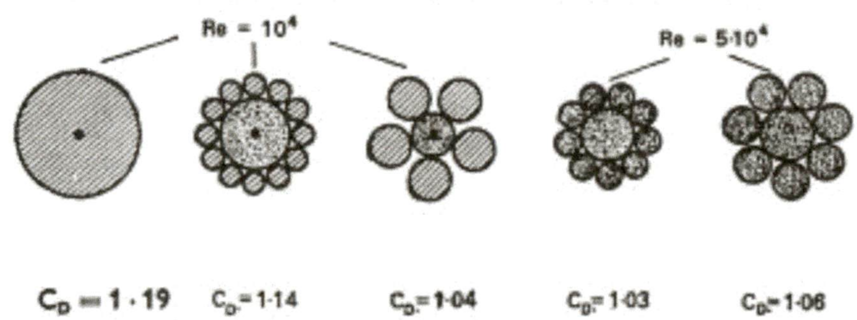
FIG. 3.22. Drag coefficients for triangular tower, with wind perpendicular to one face.

3.4.2. *Other Factors*

In calculations on lattice structures several other factors should be considered.

(i) *The wind loading on guys*. Drag coefficients for various cable cross-sections are given in Table 3.4.

TABLE 3.4. DRAG COEFFICIENTS OF STRANDED WIRES, STEEL CABLES AND ROPES[5]



(ii) *Ice accumulation*. The standard design ice thickness of $\frac{1}{2}$ in should be treated with caution, particularly where lattice members are less than 2 in apart. It is also sometimes stated that high winds do not accompany severe icing; this may be so, but in temperate climates heavy icing can be followed by high winds before thawing.

(iii) *Dynamic and oscillatory effects*. This chapter has only considered static effects on basic shapes and trusses, but individual members and complete structures can be oscillated by the wind; this is discussed in Chapter 5. Guys are also liable to large-amplitude oscillations, which have been known to excite the mast as a secondary effect.

3.5. Meshes

Although the air-stream may not be stopped, locally, when a mesh is placed in it, nevertheless it loses momentum and the velocity through the mesh gaps is increased.

There is a resultant loss of pressure through the mesh, defined in a non-dimensional manner as

$$K \equiv (P_1 - P_2)/q_{\text{average}} \tag{3.17}$$

where p_1 and p_2 are the static pressures upstream and downstream of the mesh, and average q is based on the mean of the upstream and downstream velocities. Although K is not the drag coefficient, it is uniquely related to it, and K is calculated separately for convenience. K can also be used as a similarity criterion for model tests on mesh structures.

For meshes with sharp edges,(5,42) normal to the wind,

$$K = \left(\frac{0{\cdot}5 + \phi}{1 - \phi}\right)^2 \tag{3.18}$$

where ϕ is the solidity ratio calculated in the usual manner.

For meshes with rounded edges, normal to the wind,

$$K = \left(\frac{\phi}{1 - \phi}\right)^2. \tag{3.19}$$

There is no algebraic expression connecting K with $C_{D,\text{mesh}}$ where $C_{D,\text{mesh}}$ is defined by

$$\text{Mesh drag force} = C_{D,\text{mesh}}\, Aq.$$

A is the total enclosed area, and q is based on the approach wind velocity. The relationship between K and $C_{D,\text{mesh}}$ is shown in Fig. 3.23. For values of $K < 1$, the values of $C_{D,\text{mesh}}$ are valid for perimeter aspect ratios of any value, but for $K > 1$ the correlation only holds for aspect ratios approaching 1, and the drag tends to that of a solid square or disc.

When the mesh is inclined to the wind, the variation in drag is again a function of the mesh type. Figure 3.24a, b(43) give families of curves for round wire and expanded

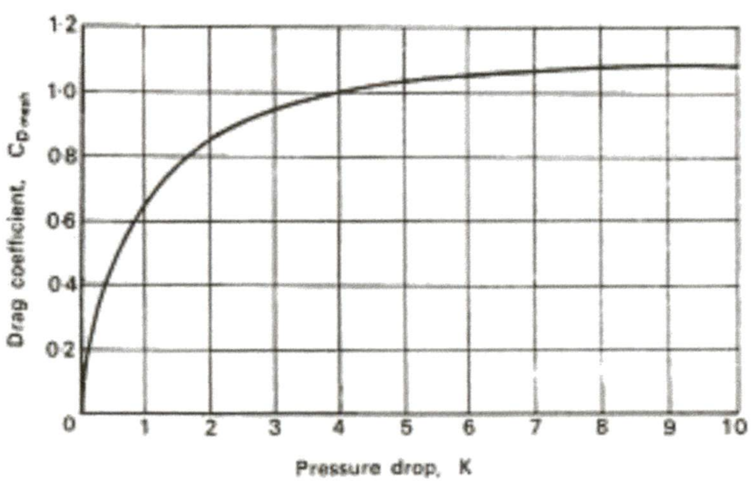


FIG. 3.23. Mesh drag coefficient for various values of pressure drop.

metal screens. The appropriate value of the $C_{D,\,mesh}/\phi$ ratio is chosen, which determines, from the $\beta = 0°$ intercept, the necessary yaw curve. In the absence of further data, Fig. 3.24b may be used for all sharp-edged meshes.

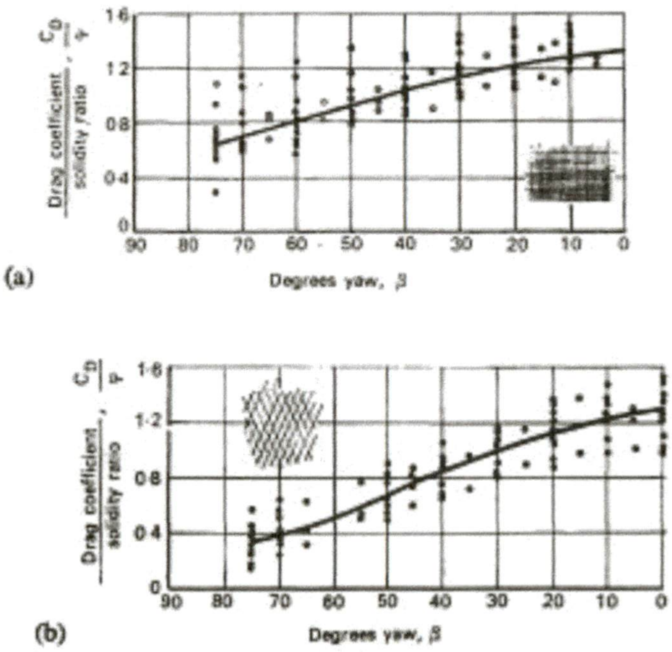


FIG. 3.24. Drag coefficients for two types of screens.[43] (a) Wire-mesh screens. (b) Expanded metal screens.

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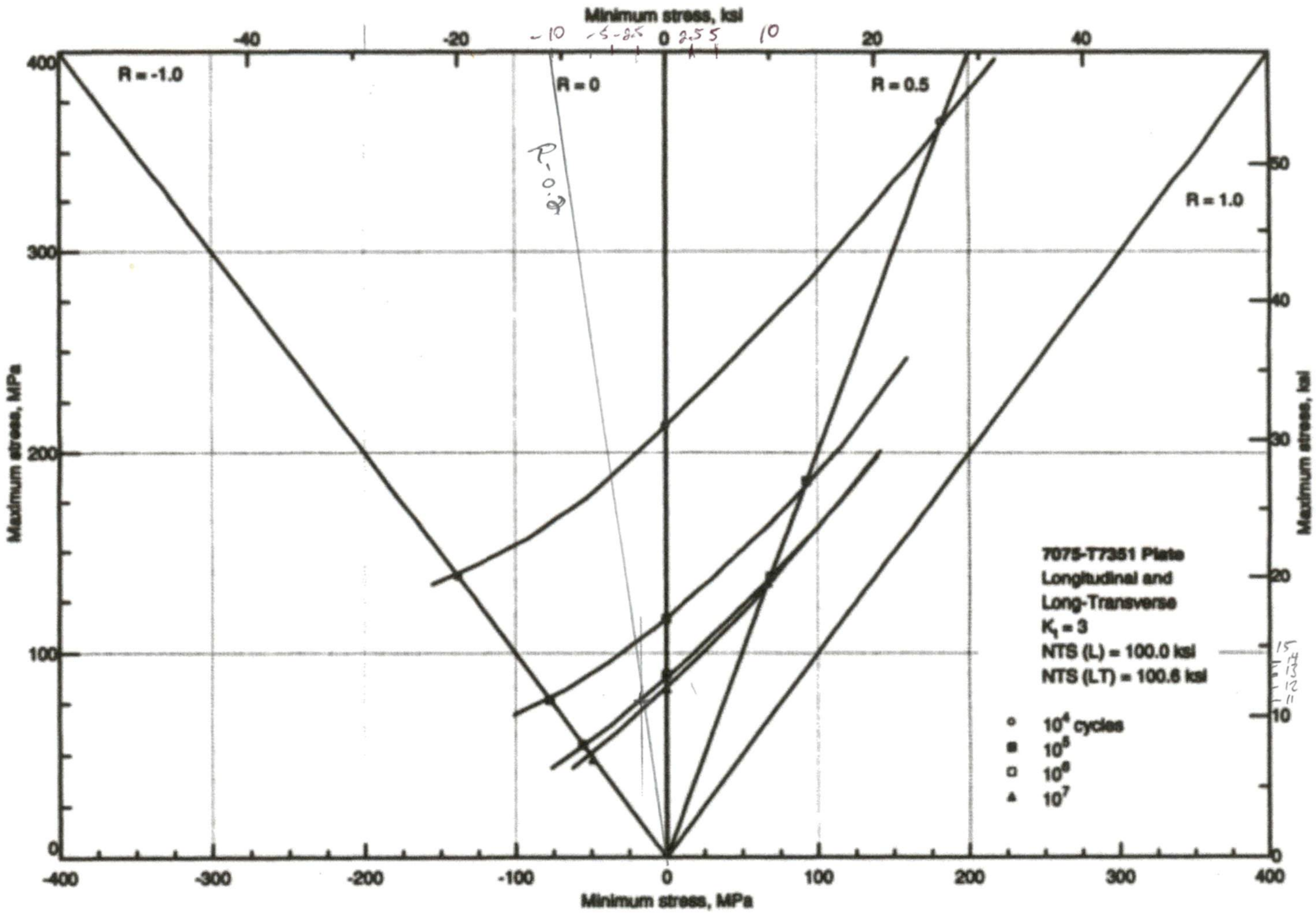

Fig. 110 7075-T7351 notched axial fatigue ($K_t = 3$). Source: Alcoa, 1970

Between 10^6 and 10^7 cycles

FROM: FATIGUE DATA BOOK: LIGHT STRUCTURAL ALLOYS
BY ASM INTERNATIONAL

(GOOGLE BOOKS)

* BAR WE RECEIVED. QQ-A-225/9

FIX IN ER 1009.01

FIX ON DWGS.

Table 3.7.6.0(d). Design Mechanical and Physical Properties of 7075 Aluminum Alloy Bar, Rod, and Shapes: Rolled, Drawn, or Cold-Finished

Specification	AMS 4122, AMS 4123, AMS 4186, AMS 4187, and AMS-QQ-A-225/9								AMS 4124 and AMS-QQ-A-225/9	
Form	Bar, rod, and shapes: rolled, drawn, or cold-finished									
Temper	T6, T651, and								T73[b] or T7351	
Thickness[c], in.	≤1.000		1.001-2.000							
Basis	A	B	A	B						
Mechanical Properties:										
F_{tu}, ksi:										
L	77	79	77	79						
LT	77[d]	79[d]	75[d]	77[d]						
F_{ty}, ksi:										
L	66	68	66	68						
LT	66[d]	68[d]	66[d]	68[d]						
F_{cy}, ksi:										
L	64	66	64	66						
LT	...	...	...	...						
F_{su}, ksi	46	47	46	47						
F_{bru}[f], ksi:										
(e/D = 1.5)	100	103	100	103						
(e/D = 2.0)	123	126	123	126	123	[illegible]				
F_{bry}[f], ksi:										
(e/D = 1.5)	86	88	86	88	86	88	86	88	81	81
(e/D = 2.0)	92	95	92	95	92	95	92	95	100	100
e, percent (S-basis):										
L	7	...	7	...	7	...	7	...	10	10
E, 10^3 ksi	10.3									
E_c, 10^3 ksi	10.5									
G, 10^3 ksi	3.9									
μ	0.33									
Physical Properties:										
ω, lb/in.^{3}	0.101									
C, K, and α	See Figure 3.7.6.0									

7075
QQ-A-225/9
F_{tu} = 77 ksi

a Design allowables were based upon data obtained from testing of T6 and T651 material and from samples of material, supplied in the O or F temper, which were heat treated to T62 temper to demonstrate response to heat treatment by suppliers.
b Design allowables were based upon data obtained from testing T73 and T7351 temper material and from testing samples of material, supplied in the O or F temper, which were heat treated to T73 temper to demonstrate response to heat treatment by suppliers.
c For rounds (rod) maximum diameter is 4 inches; for square bar, maximum size is 3½ inches; for rectangular bar, maximum thickness is 3 inches with corresponding width of 6 inches; for rectangular bar less than 3 inches in thickness, maximum width is 10 inches.
d Caution: This specific alloy, temper, and product form exhibits poor stress-corrosion cracking resistance in this grain direction. It corresponds to an SCC resistance rating of D, as indicated in Table 3.1.2.3.1(a).
ST grain direction.
e ST grain direction.
f Bearing values are "dry pin" values per Section 1.4.7.1.

* BAR WE RECEIVED.
QQ-A-225/9

FIX IN ER 1009.01
FIX ON DWGS.

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Temper	T6, T651, and T62[a]								T73[b] or T7351	
Thickness[c], in.	≤1.000		1.001-2.000		2.001-3.000		3.001-4.000		0.375-2.000	2.001-3.000
Basis	A	B	A	B	A	B	A	B	S	S
Mechanical Properties:										
F_{tu}, ksi:										
L	77	79	77	79	77	79	77	79	68	68
LT	77[d]	79[d]	75[d]	77[d]	72[d]	74[d]	69[d]	71[d]	...	65[e]
F_{ty}, ksi:										
L	66	68	66	68	66	68	66	68	56	56
LT	66[d]	68[d]	66[d]	68[d]	63[d]	65[d]	60[d]	62[d]	...	52[e]
F_{cy}, ksi:										
L	64	66	64	66	64	66	64	66	54	54
LT	...	...	...	...	...	...	...	...	...	55[e]
F_{su}, ksi	46	47	46	47	46	47	46	47	42	40
F_{bru}[f], ksi:										
(e/D = 1.5)	100	103	100	103	100	103	100	103	101	101
(e/D = 2.0)	123	126	123	126	123	126	123	126	131	131
F_{bry}[f], ksi:										
(e/D = 1.5)	86	88	86	88	86	88	86	88	81	81
(e/D = 2.0)	92	95	92	95	92	95	92	95	100	100
e, percent (S-basis):										
L	7	...	7	...	7	...	7	...	10	10
E, 10^3 ksi	10.3									
E_c, 10^3 ksi	10.5									
G, 10^3 ksi	3.9									
μ	0.33									
Physical Properties:										
ω, lb/in.^{3}	0.101									
C, K, and α	See Figure 3.7.6.0									

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ST grain direction.

e ST grain direction.

f Bearing values are "dry pin" values per Section 1.4.7.1.

7075

QQ-A-225/9

$F_{tu} = 77$ ksi

Section 23.1323(b) requires the system error, including position error, but excluding instrument error, not to exceed 3 percent of CAS or 5 knots, whichever is greater, in the designated speed range.

(3) *Compressibility.* For many years CAS was used for design airspeeds. However, as speeds and altitudes increased, a compressibility correction became necessary because airflow produces a total pressure on the pitot head that is greater than if the flow were incompressible. We now use EAS as a basis for design airspeeds (§ 23.235). Values of CAS versus EAS may be calculated or you may use the chart in Appendix 7, figure A7-5, to convert knots CAS to EAS.

3. GPS Method. The Global Positioning System (GPS) method consists of using a GPS unit to determine ground speed, which is then used to calculate true airspeed. Any commercial GPS unit can be used that produces consistent results. Once true airspeed is calculated, the data reduction is nearly identical to the speed course method described previously. One difference is that the scale altitude correction factor (ΔV_c the difference between CAS and EAS as shown in figure A7-5) may be significant at higher altitudes and speeds that may be flown with this method. Specifically, you will solve the following equation for (ΔV_{pec}):

$$V_i + \Delta V_{ic} + \Delta V_{pec} + \Delta V_c = V_{true} * \sqrt{\sigma}$$

And then, assuming that all of the pitot-static error is in the static port, you may calculate the altitude position, error, ΔH_{pec}, as described in the Trailing Bomb/Cone Method.

a. Test Conditions.

(1) *Air Quality.* The air should be as smooth as possible with a minimum of turbulence. The wind velocity and direction must be constant for this method to give correct results.

(2) *Weight and C.G.* Same as the speed course method.

(3) *Altitude.* The altitude is not critical, but it should be chosen where the air is smooth and the winds are constant.

(4) *Speed Range.* Any speed at which the aircraft can be stabilized in level flight (see Figure A9-2).

(5) *Runs* . Three runs per airspeed are required to calculate one true airspeed. The three runs must be done at the same indicated speed and altitude on different headings. The headings should be 60 to 120 degrees apart.

(6) *Configuration.* Same as the speed course method.

PEC → Position Error Correction

b. Test Procedures.

(1) Stabilize the airplane in steady level flight at the desired test speed configuration. Record the indicated airspeed, pressure altitude (29.92 set), outside air temperature and configuration of the aircraft.

(a) Record both ground track and ground speed from the GPS unit once the values are stable (this can take up to 10 seconds after stabilizing).

(b) Turn 60 to 120 degrees either direction and record the new ground track and speed once restabilized at the same airspeed and altitude on the new heading. Minor variations in altitude (up to 100 feet) are much preferred to any variation in airspeed from the initial value. A one knot change in indicated airspeed will cause at least a one knot change in true airspeed, but 100 feet of altitude only causes on the order of 1/2 of 1 percent change in the density ratio, σ.

(c) Turn another 60 to 120 degrees in the same direction and record a third set of ground track and speeds.

(2) Once you have three sets of ground track and speed for a given indicated airspeed and configuration, repeat steps (1)(a) through (1)(c) above at sufficient increments, to provide an adequate calibration curve for each of the configurations.

c. Data Reduction. The best way to calculate true airspeed from the three sets of ground tracks and speeds is with a personal computer spreadsheet. The following solution was developed assuming that the three legs flown had the same true airspeed (indicated airspeed, OAT, and pressure altitude were identical) and that the wind did not change during the three legs. The table shows the spreadsheet equations for one popular spreadsheet program that will solve the problem. Note that wind speed and direction are intermediate outputs. If a series of points are done at nearly the same time, altitude and geographic location, then the consistency of the calculated wind speed and direction will be an indicator of the validity and accuracy of the calculated true airspeeds.

	A	B	Result
1	Ground Speed 1	184	184
2	Track 1	265	265
3	Ground Speed 2	178	178
4	Track 2	178	178
5	Ground Speed 3	185	185
6	Track 3	82	82
7	X1	=B1*SIN(PI()*(360-B2)/180)	183.3
8	Y1	=B1*COS(PI()*(360-B2)/180)	-16.0
9	X2	=B3*SIN(PI()*(360-B4)/180)	-6.2
10	Y2	=B3*COS(PI()*360-B4)/180)	-177.9
11	X3	=B5*SIN(PI()*(360-B6)/180)	-183.2
12	Y3	=B5*COS(PI()*(360-B6)/180)	25.7
13	M1	=-1*(B9-B7)/(B10-B8)	-1.17
14	B1	=(B8+B10)/2-B13*(B7+B9)/2	6.71
15	M2	=-1*(B11-B7)/(B12-B8)	8.77
16	B2	=(B8+B12)/2-B15*(B7+B11)/2	4.42
17	Wx	=(B14-B16)/(B15-B13)	0.2
18	Wy	=B13*B17+B14	6.4
19	Wind Speed	=SQRT(B17^2+B18^2)	6.4
20	Wind Direction	=MOD(540-(180/PI()*ATAN2(B18,B17)),360)	177.9
21	True Airspeed	=SQRT((B7-B17)^2+(B8-B18)^2)	184.4

X **4. Pace Airplane Method.** An airplane whose pitot static systems have been calibrated by an acceptable flight test method is used to calibrate the pitot static systems of a test aircraft.

a. Test Conditions. Smooth ambient flight conditions

b. Test Procedures. The pace airplane is flown in formation with the test airplane at the same altitude and speed. The aircraft must be close enough to ensure that the relative velocity is zero yet far enough away so that the pressure fields of the two airplanes do not interact. Readings are coordinated by radio.

c. Data to be recorded

(1) Test Airplane airspeed (V_{iT}) kts

(2) Test Airplane Pressure Altitude (H_{iT}) ft

AMI Metals, Inc.

THE AEROSPACE MATERIAL SPECIALIST

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Aluminum Plate and Sheet (North America)

Grade	Temper			Surface	Material Specifications
2014	0			Bare	AMS-4028
	T6	T651			AMS-4029
	0	T6			DMS-1580
	0	T3	T6	Clad	AMS-QQ-A-250/3
	0		T6	Clad 1 Side	DMS-2074
2024	0	T3	T81	Bare	AMS-QQ-A-250/4
	0				AMS-4035, BAMS 516-010
	T3	T351			AMS-4037, FMS-1010
	T3	T351	T81		5PTM7G22
	T851				
	T4				CMMP-020
	T4	T3	T81	Clad	AMS-QQ-A-250/5
	0				AMS-4040, BMS-7-305
		T3	T351		AMS-4041
	T4				CMMP-020
		T3	T351		AMS-4036
	0			Clad 1 Side	AMS-4077
	0, T3	T4, T42	T62		MMS-1412 (All Tempers)
			T72,T81		MEP 02-015
2124	T351	T851	T8151	Bare	AMS-QQ-A-250/29, AMS-4101, FMS-3002 FMS-3008, 5PTM7G08, GM-2007, MMS-1432
2219	0	T31	T37	Bare	AMS-QQ-A-250/30, AMS-4031
	T81	T87	T351		
	T851				
	0	T31	T81	Clad	AMS-4094,AMS-4095,AMS-4096,DMS-1719 BMS-7-110
6013		T4		Bare	AMS-4347
			T6		AMS-4216
		T4	T6		FMS-3061
6061	0	T4	T6	Bare	AMS-QQ-A-250/11, ASTM-B209
	0				AMS-4025
	T4	T451			AMS-4026
	T6	T651			AMS-4027

Grade	Temper			Surface	Material Specifications
7050					, BMS7-323 Type I, III, BAMS-516-003
					MMS-1439, MMS-1420, 5PTM7B02 5PTM7T08
					BAMS-516-001, CMMP-010, LMA-M7050
					DMS-2233, DMS-2459
	T7651				AMS-4201, BAMS-516-001
		T7451			MEP 02-014
7075	0	T6	T73	Bare	AMS-QQ-A-250/12
	0				AMS-4044, BAMS 516-011
	T6	T651	T76		AMS-QQ-A-250/24, AMS-4045
	T7351				AMS-4078
	T7651	T6		Clad	AMS-QQ-A250/13, AMS-QQ-A-250/25
	0				AMS-4048
	T6	T651			AMS-4049
	T73				MMS-159
7475	T6			Bare	AMS-4084
	T761				AMS-4085
	T7651				AMS-4089
	T651				AMS-4090
	T7351				AMS-4202, BAMS-516-002
	0	T61	T761		DMS-2234, DMS-2281, 5PTM7T13
	T7651	T7351			FMS-3004
	T761	T61		Clad	AMS-4100
					AMS-4207

Scroll up for North America

Aluminum Plate and Sheet (Europe)

Grade	Temper		Surface	Material Specifications
2014	T6		Bare	L-165, L-167
	T4	T6	Clad	L-164, L-165, L-166, L-167
	T3		Bare	ABM-1-6095 (A380 ONLY), ASNA-3010,
	T351			ASNA-3011, ASNA-3012
	T3		Clad	ABM 1-1005, AIMS-03-02-020, IPS-03-04-011-01

2024	 T42 T351 T4 0 F			L-109, S07-1009, 3.16413, L-100, LN-9073 DAN-424/1 ASNA-3042, ASNA-3045, IPS-03-04-012-01 ABM 1-7067, AIMS-03-04-014 ABM 1-7068, AIMS-03-04-010 AIMS-03-04-009, AIMS-03-05-010 AIMS-03-04-024, ASNA-6098 S07-1010, ABM 1-7068, L-100, L-110, ABM 1-7068, ASNA-3042
2219	0		Clad	CR 1.1.0.82
6061	T4 T42 T6		Bare	ABM 2-6027, ASNA-3046 ASNA-3001 ASNA-3047
7010/7050 7040/7050	T7651 T7451 T7451 T76		Bare Clad	ABM 3-1029, ABM 3-1030, ABM 3-1032 AIMS-03-02-022, ASNA-3048, ASNA-3098 AIMS-03-02-019, prEN-3982 ABM 3-7045
7075	T6 T6	 T62	Bare Clad	ASNA-3051 DIN-EN-2092
7175	T7351		Bare	ASNA-3050
7475	T7351 T7651 T76		Bare Clad	AIMS-03-02-009 AIMS-03-04-029 ASNA-3096, IPS-03-04-029-01, IPS-03-04-029-02

SPECIFICATION BY COMPANY

COMPANY	SPECIFICATION	ALLOY	TEMPER
AIRBUS FRANCE	IGC 04-32-232	2214	T351,T651
(formerly Aerospatiale)	IGC 04-32-311/319/324	7010	T7451/T651/T7651
	IGC 04-32-411	2024	T351
	IGC 04-32-441	2618A	T351.T851
	IGC 04-32-471	7075	T7351
	IGC 04-32-471A	7175	T7351
	ASN-A-3005/3098/3101	7010	T651/T7451/T7651
	ASN-A-3009	7075	T7351
	ASN-A-3011	2024	T351
	ASN-A-3050	7175	T7351

Castle Reference	Product Form	Commodity	Spec	Grade	Thickness & Description	Temper
1	Plate	Aluminium	ASNA3050	7175	10.0000 MM.PL.7175.T7351.ALUMINUM.1250.0000 MM.2500.0000 MM	T7351
2	Plate	Aluminium	ABS5064 AIMS03-02-008	7175	15.0000 MM.PL.7175.T7351.ALUMINUM.1219.2000 MM.3657.6000 MM	T7351
3	Plate	Aluminium	ASNA3050	7175	20.0000 MM.PL.7175.T7351.ALUMINUM.1250.0000 MM.2500.0000 MM	T7351
4	Plate	Aluminium	ABS5064	7175	20.0000 MM.PL.7175.T7351.ALUMINUM.1250.0000 MM.2500.0000 MM	T7351
5	Plate	Aluminium	ABS5064	7175	22.0000 MM.PL.7175.T7351.ALUMINUM.1219.2000 MM.3657.6000 MM	T7351
6	Plate	Aluminium	ASNA3050	7175	30.0000 MM.PL.7175.T7351.ALUMINUM.1250.0000 MM.2500.0000 MM	T7351
7	Plate	Aluminium	ASNA3050	7175	35.0000 MM.PL.7175.T7351.ALUMINUM.1250.0000 MM.2500.1220 MM	T7351
8	Plate	Aluminium	ASNA3050	7175	50.0000 MM.PL.7175.T7351.ALUMINUM.1250.0000 MM.2500.0000 MM	T7351

AEROSPACE PLATE

SUMMARY OF SPECIFICATIONS

ALLOY	TEMPER	OWNER	SPECIFICATION	REV	SPEC. MAX THICKNESS
2014	O	SAE	AMS 4028	G	1.000
		ASTM	ASTM B 209	07	0.499
	T651	SAE	AMS 4029	K	4.000
		SAE	AMS-QQ-A-250/3		4.000
		ASTM	ASTM B 209	07	4.000
		Boeing	DMS 1580	A	3.000
		Boeing	MMS 1112	6	3.000
2014A	T651	BSI	BS L. 93	2	5.512
2024	O	SAE	AMS 4035	K	1.750
		SAE	AMS-QQ-A-250/4	A	1.750
		ASTM	ASTM B 209	07	0.499
	T351	Airbus	ABM 1-1005	1	4.000
		French National	AIR 9048-630	1	3.150
		SAE	AMS 4037	N	4.000
		SAE	AMS-QQ-A-250/4	A	4.000
		Aerospatiale	ASN-A3011	K	3.937
		ASTM	ASTM B 209	07	4.000
		Cessna	CMMP 025	R	4.000
		European	EN 2419	P2	3.150
		BSI	BS L. 97	2	5.512
		German Aerospace	WL 3.1354	1	5.512
	T851	SAE	AMS-QQ-A-250/4	A	1.499
		ASTM	ASTM B 209	07	1.499
		Northrop Grumman	GM2007	C	6.000
2124	T851	SAE	AMS 4101	C	6.000
		SAE	AMS-QQ-A-250/29		6.000
		Eclipse	EAC MS1002	F	6.000
		Eclipse	EAC MS1003	E	6.000
		Lockheed	FMS-3002	A	6.000
		Lockheed	FMS-3008	B	6.000
		Boeing	MB0170-072	F	6.000
		Boeing	MMS 149	L	6.000
2219	O	SAE	AMS 4031	G	2.000
		SAE	AMS-QQ-A-250/30		2.000
		ASTM	ASTM B 209	07	2.000
	T37	SAE	AMS-QQ-A-250/30		5.000
		ASTM	ASTM B 209	07	5.000
	T851	SAE	AMS 4295	B	6.000
		SAE	AMS-QQ-A-250/30		6.000
		ASTM	ASTM B 209	07	6.000
	T87	SAE	AMS-QQ-A-250/30		5.000
		ASTM	ASTM B 209	07	5.000
6061	O	SAE	AMS 4025	K	3.000
		SAE	AMS-QQ-A-250/11		3.000
		ASTM	ASTM B 209	07	3.000
	T451	SAE	AMS 4026	L	3.000
		SAE	AMS-QQ-A-250/11		3.000
		ASME	ASME SB 209	2004	3.000
		ASTM	ASTM B 209	07	3.000
	T651	SAE	AMS 4027	M	6.000
		SAE	AMS-QQ-A-250/11		6.000
		ASME	ASME SB 209	2004	6.000
		ASTM	ASTM B 209	07	6.000
		US Gov't.	MIL-DTL-46027	J	6.000
		BAe Systems	OAS-STD-9520	A	1.500
		BAe Systems	OAS-STD-9521	A	1.001
		BAe Systems	OAS-STD-9522	A	0.750
		BAe Systems	OAS-STD-9523	A	2.000

ALLOY	TEMPER	OWNER	SPECIFICATION	REV	SPEC. MAX THICKNESS
7050	F	Otto Fuchs	OFWN 4037	4	8.000
	T7451	Airbus	AIMS 03-02-022	6	7.874
		SAE	AMS 4050	H	8.000
		Aerospatiale	ASN-A3048	K	5.906
		Bombardier	BAMS 516-003	NC	8.000
		Boeing	BMS 7-323D TYPE I	D	8.500
		Boeing	BMS 7-323D TYPE III	D	8.500
		Cessna	CMMP 025	R	8.000
		Boeing	DMS 2233	G	6.000
		Boeing	DMS 2459	C	8.000
		Eclipse	EAC MS1004	E	8.000
		Eclipse	EAC MS1005	E	8.000
		Lockheed	LMA-M7050B	C	8.000
		Embraer	MEP 02-014	L	8.500
		Boeing	MMS 1420	G	6.000
		German Aero	WL 3.4144	1	5.906
	T7651	Airbus	ABM 3-1029	5	4.724
		SAE	AMS 4201	E	3.000
		Bombardier	BAMS 516-001	NC	3.000
		Cessna	CMMP 025	R	5.000
		Boeing	DMS 2233	G	3.000
		Eclipse	EAC MS MP 0162	E	6.000
7075	O	SAE	AMS 4044	K	2.000
		SAE	AMS-QQ-A-250/12		2.000
		ASTM	ASTM B 209	07	2.000
		McDonnell Douglas	STM0815-01	A	4.000
	T651	SAE	AMS 4045	J	4.000
		SAE	AMS-QQ-A-250/12		4.000
		ASTM	ASTM B 209	07	4.000
		Cessna	CMMP 025	R	3.000
	T7351	Aerospatiale	AIR 9048-690	1	3.937
		SAE	AMS 4078	G	4.000
		SAE	AMS-QQ-A-250/12		4.000
		ASTM	ASTM B 209	07	4.000
		Cessna	CMMP 025	R	5.000
		Eclipse	EAC MS1011	E	4.000
		Boeing	MMS 159	N	4.000
		Fokker	TH 5.316/5	15	4.724
		German Aero	WL 3.4364	1	3.934
	T7651	SAE	AMS-QQ-A-250/24	A	2.000
		SAE	AMS-QQ-A-250/25	A	1.000
		ASTM	ASTM B 209	07	2.000
7175	T7351	Airbus	AIMS 03-02-008	4	3.937
		Aerospatiale	ASN-A3050	L	3.937

This list is not necessarily up to date. Kaiser Aluminum may not be approved to produce every item listed.

Table 3.1.2.3.1(c). Maximum Specified Tension Stress at Which Test Specimens Will Not Fail in 3½% NaCl Alternate Immersion Test[a] for Various Stress Corrosion Resistant Aluminum Alloy Rolled Bars, Rods, and Extrusions

Alloy and Temper	Product Form	Test Direction	Thickness, inches	Stress, ksi	Referenced Specifications
7075-T73-T7351	Rolled Bar and Rod	ST	0.750-3.000	42[b]	AMS-QQ-A-225/9, AMS 4124, ASTM B211
2219-T8511	Extrusion	ST	0.750-3.000	30	AMS 4162, AMS 4163
7049-T73511	Extrusion	ST	0.750-2.999	41[c]	AMS 4157
			3.000-5.000	40[c]	
7049-T76511[d]	Extrusion	ST	0.750-5.000	20	AMS 4159
7050-T73511	Extrusion	ST	0.750-5.000	45	AMS 4341
7050-T74511	Extrusion	ST	0.750-5.000	35	AMS 4342
7050-T76511	Extrusion	ST	0.750-5.000	17	AMS 4340
7075-T73-T73510-T73511	Extrusion	ST	0.750-1.499	45[b]	AMS-QQ-A-200/11, AMS 4166, AMS 4167, ASTM B 211
			1.500-2.999	44[b]	
			3.000-4.999	42[b]	
			3.000-4.999	41[b,e]	
7075-T76-T76510-T76511	Extrusion	ST	0.750-1.000	25	AMS-QQ-A-200/15, ASTM B 221
7149-T73511[d]	Extrusion	ST	0.750-2.999	41[c]	AMS 4543
			3.000-5.000	40[c]	
7150-T77511	Extrusion	ST	0.750-2.000	25	AMS 4345
7175-T73511	Extrusion	ST	0.750-2.000	44	AMS 4344

a Most specifications reference ASTM G 47, which requires exposures of 10 days for 2XXX alloys and 20 days for 7XXX alloys in ST test direction.
b 75% of specified minimum longitudinal yield strength.
c 65% of specified minimum longitudinal yield strength.
d Design values are not included in MMPDS.
e Over 20 square inches cross-sectional area.

DO NOT USE STRESS VALUES FOR DESIGN

Table 3.1.2.1.6. Values of Room-Temperature Plane-Strain Fracture Toughness of Aluminum Alloys[a]—Concluded

Alloy/Temper[b]	Product Form	Orien-tation[c]	Product Thickness Range, inches	Number of Sources	Sample Size	Specimen Thickness Range, inches	K_{IC}, ksi$\sqrt{in.}$ Max.	Avg.	Min.	Coefficient of Variation	Minimum Specification Value
7075-T76511	Extrusion	L-T	1.3-7.0	4	11	1.2-2.0	41	35	31	11.0	
7075-T76511	Extrusion	T-L	1.2	3	42	0.6-2.0	36	23	20	15.5	
7150-T77511	Extrusion	L-T	0.76	1	52	0.5	36	31	26	7.7	24
7150-T77511	Extrusion	T-L	0.76	1	52	0.5	27	24	21	5.1	20
7175-T6/T6511	Extrusion	T-L	----	2	25	0.8-1.0	24	21	18	7.9	
7175-T651	Plate	L-T	----	1	17	0.7-0.8	30	26	24	9.2	
7175-T651	Plate	T-L	----	1	10	0.7-0.8	26	22	20	9.8	
7175-T6511	Extrusion	L-T	----	2	14	0.8-1.0	36	32	24	13.8	
7175-T7351	Plate	L-T	----	2	30	0.7-1.6	36	33	32	3.3	
7175-T7351	Plate	T-L	----	2	32	0.7-1.6	30	27	25	4.5	
7175-T73511	Extrusion	L-T	≥0.7	5	43	0.5-1.5	47	33	23	16.0	30
7175-T73511	Extrusion	T-L	≥0.5	5	43	0.5-1.5	35	25	20	10.9	22
7175-T74	Die Forging	L-T	≥0.5	3	14	0.5-1.0	38	30	22	15.0	27
7175-T74	Die Forging	T-L	≥0.5	2	13	0.5-1.0	33	24	21	15.7	21
7175-T74	Die Forging	S-L	≥0.5	4	41	0.5-0.8	31	26	20	8.6	21
7175-T74	Hand Forging	T-L	3.0-5.0	2	10	1.0-1.5	29	26	24	4.8	25
7175-T7651	Clad Plate	L-T	----	1	53	1.5	33	32	30	4.3	
7175-T7651	Clad Plate	T-L	----	1	50	0.6	28	27	25	3.1	
7175-T7651	Plate	L-T	----	1	12	1.5	32	32	31	1.7	
7175-T7651	Plate	T-L	----	1	11	1.5	26	25	24	3.3	
7175-T76511	Extrusion	L-T	1.4-3.8	2	48	0.6-2.0	39	33	27	10.7	
7175-T76511	Extrusion	T-L	≥0.6	4	49	0.6-1.8	31	22	20	9.8	
7475-T651	Plate	L-T	----	3	34	0.9-2.0	49	38	33	9.2	30
7475-T651	Plate	T-L	0.6-2.0	2	143	0.6-2.0	43	34	27	9.8	28
7475-T651	Plate	S-L	≥0.6	1	23	0.5-1.0	36	28	20	14.9	
7475-T7351	Plate	L-T	1.3-4.0	8	151	1.3-3.0	60	47	34	10.4	d
7475-T7351	Plate	T-L	≥1.3	7	132	0.7-3.0	50	37	29	10.4	d
7475-T7351	Plate	S-L	≥0.7	7	74	0.5-1.5	36	30	25	8.7	25
7475-T7651	Plate	L-T	1.0-2.0	4	10	1.0-2.0	46	41	36	6.2	33
7475-T7651	Plate	T-L	≥1.0	2	15	0.9-2.0	50	36	29	14.5	30

a These values are for information only.

b Products that do not receive a mechanical stress-relieving process (e.g. -T73 & -T74 tempers) have the potential for induced residual stresses. As a result, care must be taken to prevent fracture toughness properties from bias resulting from residual stresses.

c Refer to Figure 1.4.12.3 for definition of symbols.

d Varies with thickness.

Table 3.7.6.0(b$_3$). Design Mechanical and Physical Properties of 7075 Aluminum Alloy Sheet and Plate—Continued

Specification	AMS-QQ-A-250/12	AMS 4078 and AMS-QQ-A-250/12													
Form	Sheet	Plate													
Temper	T73	T7351													
Thickness, in.	0.040-0.249	0.250-0.499	0.500-1.000		1.001-1.500		1.501-2.000		2.001-2.500		2.501-3.000		3.001-3.500	3.501-4.000
Basis	S	S	A	B	A	B	A	B	A	B	A	B	S	S
Mechanical Properties:														
F_{tu}, ksi:														
L	67	68	68	70	67	69	66	68	65	67	63	65	62	60
LT	67	69	69	71	68	70	67	69	66	68	64[a]	66	63	61
ST	...	...	...	...	...	...	63	65	62	64	60	62	59	57
F_{ty}, ksi:														
L	56	57	57	59	57	59	55	57	52	55	49	53	49	48
LT	56	57	57	59	57	59	55	57	52[b]	55	49[a]	53	49	48
ST	...	...	...	...	...	...	52	54	49	52	47	50	47	46
F_{cy}, ksi:														
L	55	56	56	58	56	58	53	55	50	53	47	51	47	45
LT	58	59	59	61	59	61	57	59	54	57	51	55	51	50
ST	...	...	...	...	...	...	59	61	55	58	51	55	50	48
F_{su}, ksi	38	38	38	39	38	40	39	40	39	40	38	39	38	37
F_{bru}[c], ksi:														
(e/D = 1.5)	105	102	103	106	103	106	102	106	102	105	100	103	99	96
(e/D = 2.0)	134	131	132	136	132	136	132	136	131	135	128	132	127	124
F_{bry}[c], ksi:														
(e/D = 1.5)	84	79	81	83	83	86	82	85	79	83	76	81	76	76
(e/D = 2.0)	102	95	97	100	99	102	97	101	93	99	89	96	89	88
e, percent (S-basis):														
LT	8	7	7	...	6	...	6	...	6	...	6	...	6	6
E, 10^3 ksi	10.3	10.3												
E_c, 10^3 ksi	10.5	10.6												
G, 10^3 ksi	3.9	3.9												
μ	0.33	0.33												
Physical Properties:														
ω, lb/in.^{3}	0.101													
C, K, and α	See Figure 3.7.6.0													

a S-basis. The rounded T_{99} values are as follows: F_{tu}(LT) = 65 ksi and F_{ty}(LT) = 52 ksi.

b S-basis. The rounded T_{99} value is as follows: F_{ty}(LT) = 53 ksi.

c Bearing values are "dry pin" values per Section 1.4.7.1. See Table 3.1.2.1.1.

No fatigue tables-

Table 3.7.6.0(d). Design Mechanical and Physical Properties of 7075 Aluminum Alloy Bar, Rod, and Shapes: Rolled, Drawn, or Cold-Finished

Specification	AMS 4122, AMS 4123, AMS 4186, AMS 4187, and AMS-QQ-A-225/9								AMS 4124 and AMS-QQ-A-225/9	
Form	Bar, rod, and shapes: rolled, drawn, or cold-finished									
Temper	T6, T651, and T62[a]								T73[b] or T7351	
Thickness[c], in.	≤1.000		1.001-2.000		2.001-3.000		3.001-4.000		0.375-2.000	2.001-3.000
Basis	A	B	A	B	A	B	A	B	S	S
Mechanical Properties:										
F_{tu}, ksi:										
L	77	79	77	79	77	79	77	79	68	68
LT	77[d]	79[d]	75[d]	77[d]	72[d]	74[d]	69[d]	71[d]	...	65[e]
F_{ty}, ksi:										
L	66	68	66	68	66	68	66	68	56	56
LT	66[d]	68[d]	66[d]	68[d]	63[d]	65[d]	60[d]	62[d]	...	52[e]
F_{cy}, ksi:										
L	64	66	64	66	64	66	64	66	54	54
LT	...	...	...	...	...	...	...	...	...	55[e]
F_{su}, ksi	46	47	46	47	46	47	46	47	42	40
F_{bru}[f], ksi:										
(e/D = 1.5)	100	103	100	103	100	103	100	103	101	101
(e/D = 2.0)	123	126	123	126	123	126	123	126	131	131
F_{bry}[f], ksi:										
(e/D = 1.5)	86	88	86	88	86	88	86	88	81	81
(e/D = 2.0)	92	95	92	95	92	95	92	95	100	100
e, percent (S-basis):										
L	7	...	7	...	7	...	7	...	10	10
E, 10^3 ksi	10.3									
E_c, 10^3 ksi	10.5									
G, 10^3 ksi	3.9									
μ	0.33									
Physical Properties:										
ω, lb/in.^{3}	0.101									
C, K, and α	See Figure 3.7.6.0									

a Design allowables were based upon data obtained from testing of T6 and T651 material and from samples of material, supplied in the O or F temper, which were heat treated to T62 temper to demonstrate response to heat treatment by suppliers.

b Design allowables were based upon data obtained from testing T73 and T7351 temper material and from testing samples of material, supplied in the O or F temper, which were heat treated to T73 temper to demonstrate response to heat treatment by suppliers.

c For rounds (rod) maximum diameter is 4 inches; for square bar, maximum size is 3½ inches; for rectangular bar, maximum thickness is 3 inches with corresponding width of 6 inches; for rectangular bar less than 3 inches in thickness, maximum width is 10 inches.

d Caution: This specific alloy, temper, and product form exhibits poor stress-corrosion cracking resistance in this grain direction. It corresponds to an SCC resistance rating of D, as indicated in Table 3.1.2.3.1(a).
ST grain direction.

e ST grain direction.

f Bearing values are "dry pin" values per Section 1.4.7.1.

Table 3.1.2.3.1(a). Resistance to Stress-Corrosion Ratings[a] for High-Strength Aluminum Alloy Products—Continued

Alloy and Temper[b]	Test Direction[c]	Rolled Plate	Rod and Bar[d]	Extruded Shapes	Forging
7075-T74	L	f	f	f	A
	LT	f	f	f	A
	ST	f	f	f	B
7075-T76	L	A	f	A	f
	LT	A	f	A	f
	ST	C	f	C	f
7149-T73	L	f	f	A	A
	LT	f	f	A	A
	ST	f	f	B	A
7175-T74	L	f	f	f	A
	LT	f	f	f	A
* not 73	ST	f	f	f	B
7475-T6	L	A	f	f	f
	LT	B[e]	f	f	f
	ST	D	f	f	f
7475-T73	L	A	f	f	f
	LT	A	f	f	f
	ST	A	f	f	f
7475-T76	L	A	f	f	f
	LT	A	f	f	f
	ST	C	f	f	f

a Ratings were determined from stress corrosion tests performed on at least ten random lots for which test results showed 90% conformance with 95% confidence when tested at the following stresses.

A - Equal to or greater than 75% of the specified minimum yield strength. A very high rating. SCC not anticipated in general applications if the total sustained tensile stress* is less than 75% of the minimum specified yield stress for the alloy, heat treatment, product form, and orientation.

B - Equal to or greater than 50% of the specified minimum yield strength. A high rating. SCC not anticipated if the total sustained tensile stress* is less than 50% of the specified minimum yield stress.

C - Equal to or greater than 25% of the specified minimum yield stress or 14.5 ksi, whichever is higher. An intermediate rating. SCC not anticipated if the total sustained tensile stress* is less than 25% of the specified minimum yield stress. This rating is designated for the short transverse direction in improved products used primarily for high resistance to exfoliation corrosion in relatively thin structures where applicable short transverse stresses are unlikely.

D - Fails to meet the criterion for the rating C. A low rating. SCC failures have occurred in service or would be anticipated if there is any sustained tensile stress* in the designated test direction. This rating currently is designated only for the short transverse direction in certain materials.

NOTE - The above stress levels are not to be interpreted as "threshold" stresses, and are not recommended for design. Other documents, such as MIL-STD-1568, NAS SD-24, and MSFC-SPEC-522A, should be consulted for design recommendations.

b The ratings apply to standard mill products in the types of tempers indicated, including stress-relieved tempers, and could be invalidated in some cases by application of nonstandard thermal treatments of mechanical deformation at room temperature by the user.

* The sum of all stresses, including those from service loads (applied), heat treatment, straightening, forming, etc.

Table 3.1.2.3.1(a). Resistance to Stress-Corrosion Ratings[a] for High-Strength Aluminum Alloy Products

Alloy and Temper[b]	Test Direction[c]	Rolled Plate	Rod and Bar[d]	Extruded Shapes	Forging
2014-T6	L	A	A	A	B
	LT	B[e]	D	B[e]	B[e]
	ST	D	D	D	D
2024-T3, T4	L	A	A	A	[f]
	LT	B[e]	D	B[e]	[f]
	ST	D	D	D	[f]
2024-T6	L	[f]	A	[f]	A
	LT	[f]	B	[f]	A[e]
	ST	[f]	B	[f]	D
2024-T8	L	A	A	A	A
	LT	A	A	A	A
	ST	B	A	B	C
2124-T8	L	A	[f]	[f]	[f]
	LT	A	[f]	[f]	[f]
	ST	B	[f]	[f]	[f]
2219-T351X, T37	L	A	[f]	A	[f]
	LT	B	[f]	B	[f]
	ST	D	[f]	D	[f]
2219-T6	L	A	A	A	A
	LT	A	A	A	A
	ST	A	A	A	A
2219-T85XX, T87	L	A	[f]	A	A
	LT	A	[f]	A	A
	ST	A	[f]	A	A
6061-T6	L	A	A	A	A
	LT	A	A	A	A
	ST	A	A	A	A
7040-T7451	L	A	[f]	[f]	[f]
	LT	A	[f]	[f]	[f]
	ST	B	[f]	[f]	[f]
7049-T73	L	A	[f]	A	A
	LT	A	[f]	A	A
	ST	A	[f]	B	A
7049-T76	L	[f]	[f]	A	[f]
	LT	[f]	[f]	A	[f]
	ST	[f]	[f]	C	[f]
7050-T74	L	A	[f]	A	A
	LT	A	[f]	A	A
	ST	B	[f]	B	B
7050-T76	L	A	A	A	[f]
	LT	A	B	A	[f]
	ST	C	B	C	[f]
7075-T6	L	A	A	A	A
	LT	B[e]	D	B[e]	B[e]
	ST	D	D	D	D
7075-T73	L	A	A	A	A
	LT	A	A	A	A
	ST	A	A	A	A

Table 3.1.2.1.6. Values of Room-Temperature Plane-Strain Fracture Toughness of Aluminum Alloys[a]—Continued

Alloy/Temper[b]	Product Form	Orientation[c]	Product Thickness Range, inches	Number of Sources	Sample Size	Specimen Thickness Range, inches	K_{IC}, ksi$\sqrt{in.}$				
							Max.	Avg.	Min.	Coefficient of Variation	Minimum Specification Value
7050-T7452	Hand Forging	L-T	3.5-5.5	1	11	1.5	34	31	26	8.0	d
7050-T7452	Hand Forging	T-L	3.5-7.5	1	13	1.5	22	21	18	6.7	d
7050-T7452	Hand Forging	S-L	3.5-7.5	1	17	0.8-1.5	21	19	16	7.5	
7050-T76511	Extrusion	L-T	----	2	38	0.6-2.0	40	31	27	7.8	
7075-T651	Plate	L-T	≥0.6	7	99	0.5-2.0	30	26	20	7.6	
7075-T651	Plate	T-L	≥0.5	5	135	0.4-2.0	27	22	18	8.9	
7075-T651	Plate	S-L	----	2	37	0.5-1.5	22	18	14	10.4	
7075-T6510	Extrusion	L-T	0.7-3.5	1	26	0.5-1.2	32	27	23	7.8	
7075-T6510	Extrusion	T-L	0.7-3.5	1	25	0.5-1.2	28	24	21	8.0	
7075-T6510	Forged Bar	L-T	0.7-5.0	1	13	0.6-2.0	35	29	24	11.6	
7075-T6510	Forged Bar	T-L	0.7-5.0	1	13	0.5-2.5	24	21	17	8.2	
7075-T73	Die Forging	T-L	≥0.5	1	22	0.5-0.8	25	21	18	9.9	
7075-T73	Hand Forging	L-T	----	2	10	1.0-1.5	39	31	29	8.8	
7075-T73	Hand Forging	T-L	≥1.0	2	14	1.0-1.5	27	23	20	9.0	
7075-T7351	Plate	L-T	≥1.0	8	65	0.5-2.0	36	30	25	8.2	
7075-T7351	Plate	T-L	≥0.5	6	56	0.5-2.0	47	27	21	20.1	
7075-T7351	Plate	S-L	≥0.5	3	20	0.5-1.5	38	22	17	32.5	
7075-T73511	Extrusion	T-L	1.0-7.0	1	19	0.9-1.0	22	20	19	3.7	
7075-T73511	Extrusion	L-T	≥0.9	3	28	0.7-2.0	43	35	31	9.4	
7075-T73511	Extrusion	T-L	≥0.7	3	35	0.5-1.8	35	23	12	20.3	
7075-T73511	Extrusion	S-L	≥0.5	3	15	0.4-1.0	22	20	17	9.0	
7075-T7352	Hand Forging	L-T	----	2	27	0.8-2.0	39	33	30	9.2	
7075-T7352	Hand Forging	T-L	≥0.8	3	20	0.8-2.0	33	26	23	9.9	
7075-T7651	Plate	L-T	≥0.8	6	82	0.5-2.0	43	29	22	17.8	
7075-T7651	Plate	T-L	≥0.5	7	96	0.5-2.0	28	23	20	7.6	
7075-T7651	Plate	S-L	≥0.5	5	28	0.4-0.8	20	18	15	7.7	
7075-T7651	Clad Plate	L-T	0.5-0.6	2	30	0.5-0.6	30	25	22	7.1	
7075-T7651	Clad Plate	T-L	0.5-0.6	2	56	0.5-0.6	28	24	21	7.7	

a These values are for information only.

b Products that do not receive a mechanical stress-relieving process (e.g. -T73 & -T74 tempers) have the potential for induced residual stresses. As a result, care must be taken to prevent fracture toughness properties from bias resulting from residual stresses.

c Refer to Figure 1.4.12.3 for definition of symbols.

d Varies with thickness.

Wings Engineering Limited Project No.; WPN1507

Certification Plan Review, AD1009-CP.Review-NC-26Jun2015

Aero Design Project Number 1009
Revision to STC SH08-16
Add Mounting Provisions (for Basket/Step/Bike Rack/s), Extra Large Basket and Step to suit the EC130B4

Documents Reviewed

Jeff comments inserted 13 July 2015 noted in blue

Jim comments inserted 14 Aug 2015 noted in green.

CertPlan_CP1009_1-09June2015.pdf, **R1-29Jun2015**

Cover Page

Change to read "EC130 B4" Done ✓

4.2, 2nd Paragraph need to be clearer and there needs to be some additional qualification of the material substitution and design changes. i.e.; replace with:

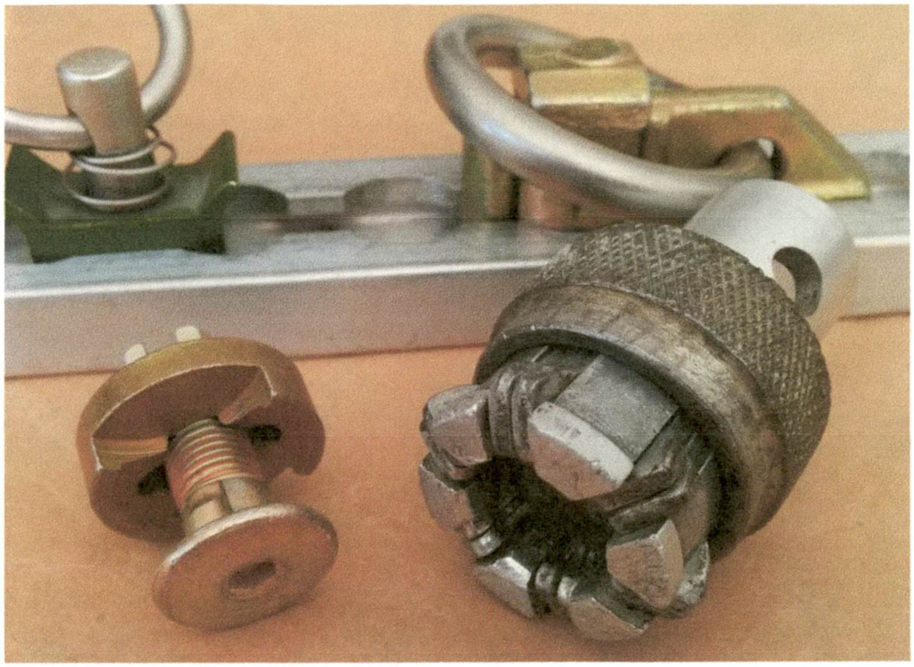
"The original Airbus billet machined 7175-TXXX Forward Cross Tube Clamps are replaced with Aero Design billet machined 7075-TXXX Clamps. These replacement clamps include integral lugs to accommodate barrel nuts in order to provide hard points for the attachment of the Fwd Beam. These hard point provisions are identical to the Aero Design hard point provisions for the Bell 206L/407 Cargo Baskets. See ER1009 for the applicable fatigue/ strength /dimensional /protection /hardware /service qualification analysis for these replacement clamps." Done ✓

4.2, Pg 7, Paragraph need clarification and qualification fig added.

The aft attachment picks up on the main **[Longitudinal? Is there a better figure for 4.2.3 because the current figure shows lateral frames.]** fuselage frames at the aft fuel cell cross member (figure 4.2.3, "A"). The aft fuel cell cross member includes the aft attachment points for the cargo swing (2557 lbs slung load), ~~which can be~~ is used to calculate the allowable loads on the frame per ERXXX. In order to install the lower aft fuselage fairing panel, which slides between the fuselage frames and landing gear fairings with little room to rotate, the aft attachment fittings cannot extend lower than the fairing panel once installed. To simplify installation and reduce the required cutout size in the fairing panel, the fitting incorporates a 5000lb ? seat ~~track type~~ stud fitting, the same as the basket attachments. The mounting beam attaches to the fitting with a 5000lb ? seat stud ~~type~~ quick disconnect claw fitting (see figure 4.2.4)~~, the same as used with the Aero Design Rappel and Cargo Deployment System~~. The claw fitting is secured ~~with a~~ via an integral locking ring feature. ~~, also used with the Rappel and Cargo Deployment System, to prevent inadvertent release.~~ Done – Note we add an external locking

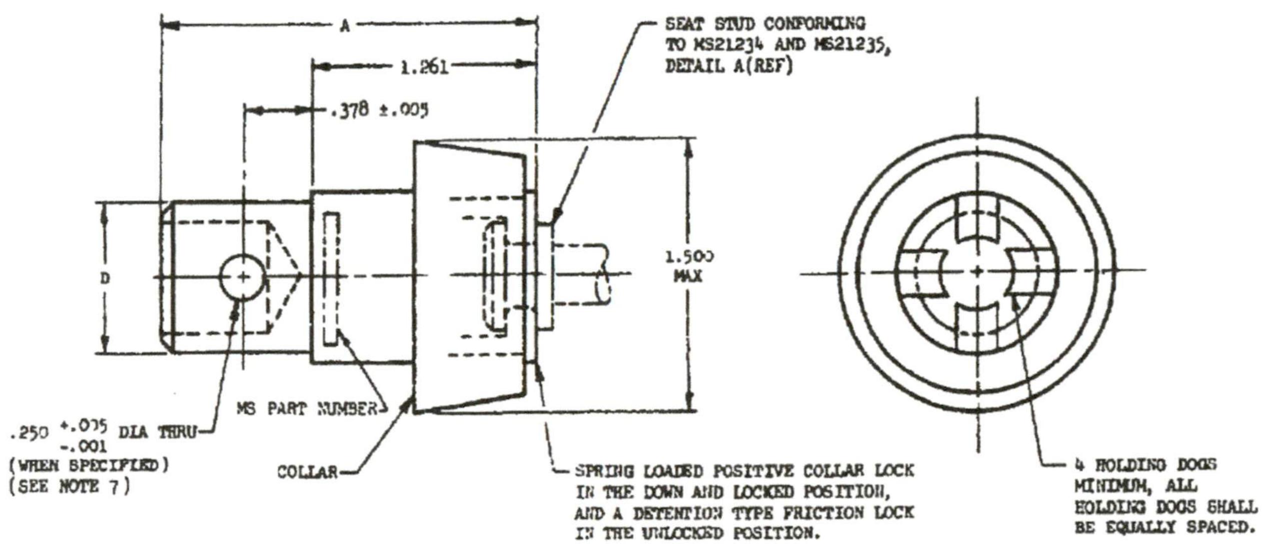
ring, maybe that wasn't clear.

Please show external locking ring detail. Added. to fig 4.2.5



The Standard Seat Track Stud Does Not Fit This Bell 212 Seat Claw Fitting
AD drawings note Ancra Seat Stud type Passenger Seat Fittings
as shown below

MS22034, Adapter, Quick Disconnect, Passenger Seat to Floor (Claw Fitting)



4.3, First Paragraph, Get to the relative basket changes quicker

~~The extra large Quick Release Cargo Basket developed by Aero Design Ltd. for the AS350 is the right size for operators using the EC130 for heli-ski, tourism, and utility contracts.~~ The only difference between the existing AS350 extra large basket (model 940) and the EC130 extra large basket (model 1009) is the attachment points are moved to the first and last hoops, which is the same configuration as the AS350 medium and short

baskets (model 764 and 776). All other construction of the basket remains the same as basket model 940. The 300 lb (136 kg) cargo load limit also remains the same. Done

Figure 4.3.1 - Model 1009 Quick Release Cargo Basket Done

4.4 How do you know that the step is required?

Please quote requirement. Part of TCDS? Customer demand? etc. Expect it is part of the TCDS, SB32-002 Industrialized Landing Gear - Section 1.D: "...Defining a series production foot step"

Figure 4.4.1 - Model 1010 Quick Release Cabin Step Done

4.5 Table

Re-title Columns 2 & 3; Max Cargo, Installed Wt Done

Are there options for Left/Right/Both sides basket installs? Yes Config #'s? Inserted

Same questions for the Step/s. Yes, inserted

Include W&B info for original step to complete the comparison? Don't have the weight, will try to get next time we are at the helicopter.

5.0 Basis of Certification

Rework this section to obtain TCCA's acceptance to use the FAA's TCDS FAR 27 requirements. i.e.; the special TCCA conditions are not applicable? and/or other justification. Reworked – thoughts?
See 5.3

5.2.1 FAA - TCDS H9EU, Revision 23

[I have noted that the FAA's TCDSs are typically more clearly written than TCCA's.]

Data Pertinent to all Models Except EC130B4 & T2 ← This CP is only for B4

Page 16, Certification Basis;

14 CFR 21.29 and part 27 effective February 1, 1965 plus Amendments 27-1 through 27-10, plus FAA Special Conditions No. 27-79-EU-23, dated August 13, 1977.

27.571 Fatigue evaluation of flight structure at Amdt 27-3 needs to be addressed:

(a) General. Each portion of the flight structure (including rotors, controls, fuselage, and their related primary attachments)...

Not a typical requirement for cargo pods/baskets.

Not applicable to EC130
Noted for bike racks
Please explain.

This ~~all~~ basis only applies to AS350. This Cert Plan is EC130 only

Page 17, 2nd Paragraph from top

For A/C incorporating mod. OP3369 (2370 kg/5225 lb mass extension) the following 14 CFR part 27 Amendments 27-1 through 27-40, are replacing the same requirement from the certification basis above : ... §571; .

27.571 Fatigue evaluation of flight structure at Amdt 27-26 needs to be addressed:

(a) [General. Each portion of the flight structure (the flight structure includes rotors, rotor drive systems between the engines and the rotor hubs, controls, fuselage, landing gear, and their related primary attachments), ...]

Needs to be discussed with Wings/AD prior to discussions with TCCA.
Discussed. See ER1009.01 Review Notes.

Pg 17, EC 130B4 Certification Basis;

14 CFR 21.29 and part 27 Amendment 27-1 through Amendment 27-32 except 14 CFR 27.952 is not adopted.

Again 27.571 at Amdt 27-26 needs to be addressed

Needs to be discussed with Wings/AD prior to discussions with TCCA.
Analysis added to ER1009.01 – similar to what has been previously accepted for our Bell 206L landing gear fittings.
Discussed. See ER1009.01 Review Notes. ✓

5.3 This Modification

Remove AC 521-004 and add SI 512-004 and 005 Done
Per CP 1002
Suggested wording for the use of the FAA's BoC, revise to suit:
The FAA's Basis of Certification is better understood internationally than TCCA's BoC and the amendment control system FAR 27 is also easier to reference/address than the amendments for CAR Std 527, therefore... ✓ Done

7.3 27.45, .51, .65, .71, .73, .75, .141, .143, .171, .173, .175, .177, .241, .251 – Flight Requirements and .547 – Main rotor structure (Mast Bending) Done

7.3.2, b,

Can you please provide an expanded description for the VXP analyzer and plans? i.e.; Honeywell? VXP model number XXX, display, data bucket, using XXX sensor/pick-ups, owner/operators' manual number, used by Airbus ??, pick-up locations iaw ??? Etc.
and/or
Note that the applicable test procedure will detail the extent of the VA pass/fail plans which will include running a baseline spectrum for comparison? Done

Notes for Airbus spectrum/limits/locations? We need to discuss limits. Airbus provides locations for dynamic balancing Maintenance Manual Chapter 05-50-00, section 6-21, *Diagnosis of defects by vibration analysis*. "Result interpretation is carried out by comparison with previously performed measurements, when the aircraft had an acceptable vibratory level (example: measurement performed upon aircraft acceptance)."

7.5 27.471, .473, .501, .549, .571 – Strength Requirements (Landing Gear) Done ✓

7.5.2, b) add The report addresses the applicable fatigue/ strength /dimensional /protection /hardware /service qualification analysis for these replacement clamps. Done ✓

7.5.5, a) add .571 Done
Added 7.8 – FAR 27.725 / .727 – Drop Tests

(7.9) 7.8 Please work in a comment and a check in the FTP to evaluate egress. Done ✓

(7.11) 7.9 Please work in a note as 7.10 that Aero Design does not use the 27.865 design requirements because of the no-passenger restrictions wrt to FAA Part 133 RLC Class A per therefore the baskets are designed to baggage compartment "requirements". Done

Appendix A

27.307 Analysis

- per ER1009? Please include the applicable report number for all analysis references. Done

27.561(c), "Side mounted bike rack/s are not located...."

- Please add a report reference where the report needs to explain how/why a deflected basket will not impede egress or penetrate the cabin. Done

27.571 Please add with FOC by DOT Done

27.807 Statement in report

- add report number Done

28.865 Add and then reference the earlier statement wrt RCL Class A. Done

Also Updated Drawings

100916
31
03
92
30

100916_0_2015-05-21.pdf, QR Mnt Provisions, Aft Beam Assy

- Why is item 7 noted "DO NOT FULLY TIGHTEN"? To allow lateral adjustment on installation to match airframe
  What is not fully tightened? Claw fitting
  How is it locked? Via Self-Locking Barrel-Nut? Yes

Everything is tightened at installation? Removed, claw fitting swapped to A/C side

NDT Requirements should be noted on drawings. NO CRACKS ALLOWED

- Welding 10x's visual?
- Machined Aluminum (and non-ferrous); FPI iaw ASTM E 1417
- Machined Steel; MPI iaw ASTM E 1444

We do not currently do NDT on any of our existing products, we do not have a qualified inspector.

You must add NDT for the AD Fwd Cross Tube Clamps. Done

Anodizing must be carefully spec'd for parts subject to fatigue see Mil-A-8625F

6.6.1 ... Where anodic coatings are required on fatigue critical components, Type I and IB coatings (see 6.1.2) are used due to the thinness of the coating (see 6.10.7).

6.1.2 Type IC and IIB. Type IC and IIB coatings provide non-chromate alternatives to Type I and IB coatings where corrosion resistance, paint adhesion, and fatigue resistance is required.

- Process sensitive therefore an approved plating shop must be used.
- US.Army_A108869_The.Effect.of.Surface.Coatings.on.the.Fatigue.Strength.of.Aluminum.Alloys. Table 2. 7075-T6
  - 80% reduction without shot peening
  - Large improvements with shot peening   Interesting, anodizing removed

ER1009.01_0_2015-07-13.pdf Mounting Provisions and (XL) Cargo Basket

Original review wrt ER1009.01_0_2015-06-03.pdf,

3.0 Basis of Certification

- reference CP's BoC or copy the FA27 BoC from the CP. Done

MathCAD General Request

- Please add a second step to all calcs to show values used. Done

Figure 5.6.1

- Show beam limit/ultimate P values on FBD to show balanced loading Done
- Please increase the FBD font sizes to 8Pt min. Done

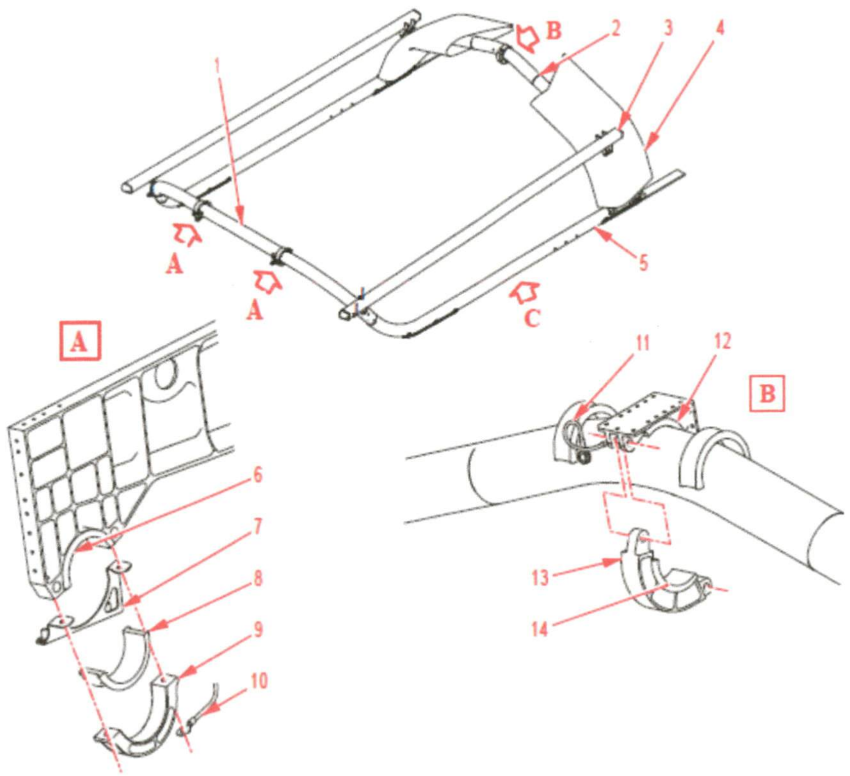
Figure 5.6.3

- See red-lined figure. Done

5.6.1 Fwd Attachment

- Please include an Airbus figure to show the 3 attachment points. SDS 32-11-00, 03? Done

Figure 1. Main Landing Gear - Detailed Description



- The small inertia loads from the gear weight should be insignificant wrt the asymmetric landing loads? Do we need to calculate the landing loads? Is the comparison to the original fitting sufficient?

  Remove these insignificant values. ✓
  You will need TCCA's agreement for the comparison analysis.
  I have provided at least three spec sheets that all note ASN-A-3050 is equivalent to 7175-T7351 and there is only this one temper available. Some note that this alloy-temper is used by Airbus. Thank you.

- Noting that the structural strength is limited by the M8 bolts is good.
- Include moment arms dimensions for the Rt calcs strap on Figure 5.6.4 Done, now fig. 5.6.6
- wrt Rt calc, Aren't there x and z components for Pman? x being drag on the gear, added to calculation
- Please call to explain the shear/tension calcs at the top of page 16. Now top of page 20. Equation solving performed by Mathcad, confirmed by hand
- MS M8 bolt = 8590 / 2454 / 1.15 ff - 1 = 2.0 Done
- WRT Fwd Clamps Airbus vs. Aero Design needs to be address wrt fatigue/ strength /dimensional /protection /hardware /service / etc. Added to section 6
- Figure 5.6.6 Does the EC130 SRM call out the Long Beam material?
  5052-O is just too far out an assumption for a keel beam. Fair enough
  i.e.; 6061-T6 would still be conservative for a heavy beam. Done
- Top of page 18. Now page 22
  Provide an MS for this evaluation. Done

5.6.2 Aft Attachment

- The 2557 Lb "Swing" Cargo Hook System has reinforced cradles iaw SB25-032.
- The 1009 system mounts on the aft cradle? No, attachment to longitudinal beam
  Can you confirm that this cradle is as strong fwd/vertically as required?
  i.e.; is it braced like the fwd cradle? Not installed on cradle
  I have a 2009 EC130 Disk and there are no IPC pages or SRM pages for the cabin floor structure or the mid-structure.

  As noted earlier.
  Please include an more representative figure showing attachment to the longitudinal members in the vicinity of the Tank Frames. done.
  i.e.; Trapezoidal Frame figure? ~~→ can't find this?~~

- Figure 5.6.7 is for the 1653 Lb "Sling" Cargo Hook attachment provision on the fwd cradle = stronger than the Swing's 2557/4 assumption. Shifting the attachment forward is not feasible, overhang on the aft end of the basket too long

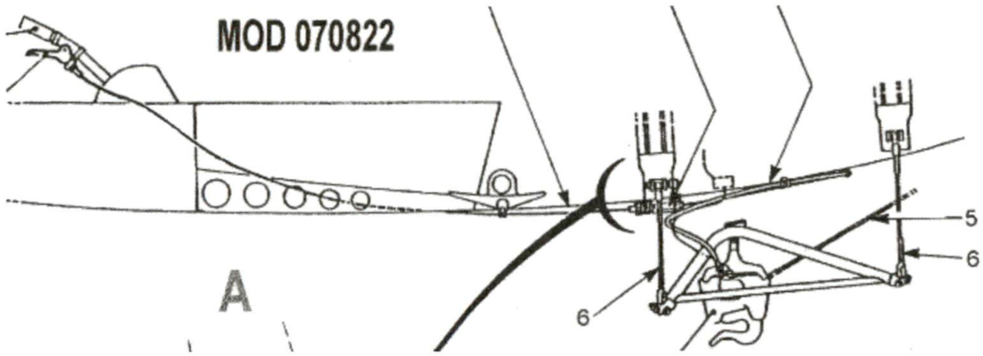
  There are a number of options to qualify the aft mounts.

  Removed. Per discussion

  Staying with your Cargo Hook evaluation please note that for the Fuel Tank mounted swing system he Cargo Hook is not centered. 1/3 vs. 1/2
  i.e.; take more credit for the Fwd Lugs

  BIG PROB *

  and it will pull 30 degrees aft with the cable arrangement shown below.



- arc tan (Pdrag_ult 510 Lbs / Pman_ult 1969 Lbs) = 14.5^{O} from vertical
  Please check calc shown and show parameters and values. 14.5^{O} does not work for the allowable loads, at 11.3-13.6 MS is positive for both directions.
- Show MS's for vert and horz comparisons. Done

5.7 Dual Basket Installation

- Add Beam Ult wt to Balance FBDs and rework moments as required. Done

6.0 Compliance with - Landing Gear add 571

- Expand review as noted earlier. Done

  Please consider 7075-T7351 and show all properties wrt 7175-T7351. i.e.; MMPDS-01 Tables 3.1.2.1.6. and 3.1.2.3.1(c)

Done, added to table.

7.0 Added FAR 27.725 / .727 Drop Test

(8.0-11.0) 7.0 Doors to 10.0 Light = All good for now

ER1010.01_0_2015-05-23.pdf, Cabin Step

All good for now.

FTP1009.03_0_2015-06-04.pdf, (XL) Cargo Basket

3.0 Add egress evaluation of Basket and Step. Done

- Single Basket configurations will have a Step installed? Yes

4.4 Documents

- Flight Authority (Flight Test Permit), Attach copy. Done
- W&B Report, Attach copy. Done
- Conformity Inspection, Attach copy of Applicant's AN B043 CIR Done
- Statement of Suitability for Flight Test, Attach copy of SI 521-004, Table F-1 Done
- Flight Test Safety Checklist, Attach copy of SI 521-004, Table F-2 Done

5.1 Test to 1.11Vne? If possible, not mandatory. What is the Vne for the AS350 Cargo Basket? No restriction. Dart EC130 basket restricted to 108 KIAS.

TR1009.02_0_2015-05-20.pdf, Load Tests, Mounting Provisions and (XL) Cargo Basket

2.0 Are you using AD barrel nuts or Airbus M8 barrel nuts for the beam attachment hardware? AN5 bolts threaded directly into fixture. Metric bolts only available from Airbus, bolts are $10+ each and regular nuts are $5!

4.2 Test Fixture

- The steel posts are going to be bolted to the floor? Yes and braced fore/aft and laterally back to floor

4.3.1 Combined Load

- Given that the Basket is mounted on the ends pulling from the fwd or the aft frame will provide the same loading into the test structure. Yes, but the horizontal keyways open forward

Red-Lined ER1009.01_0 Figure 5.6.3

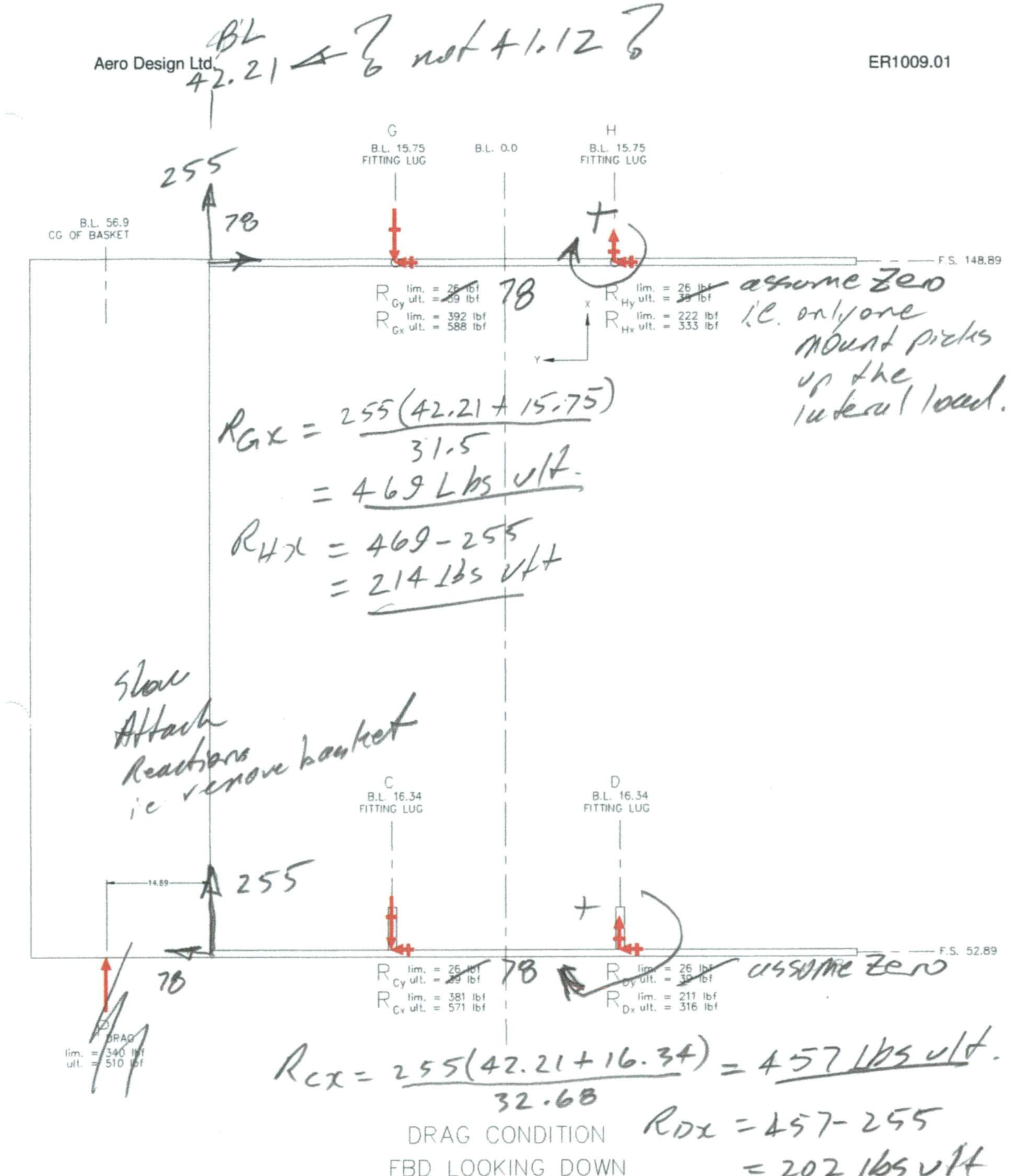
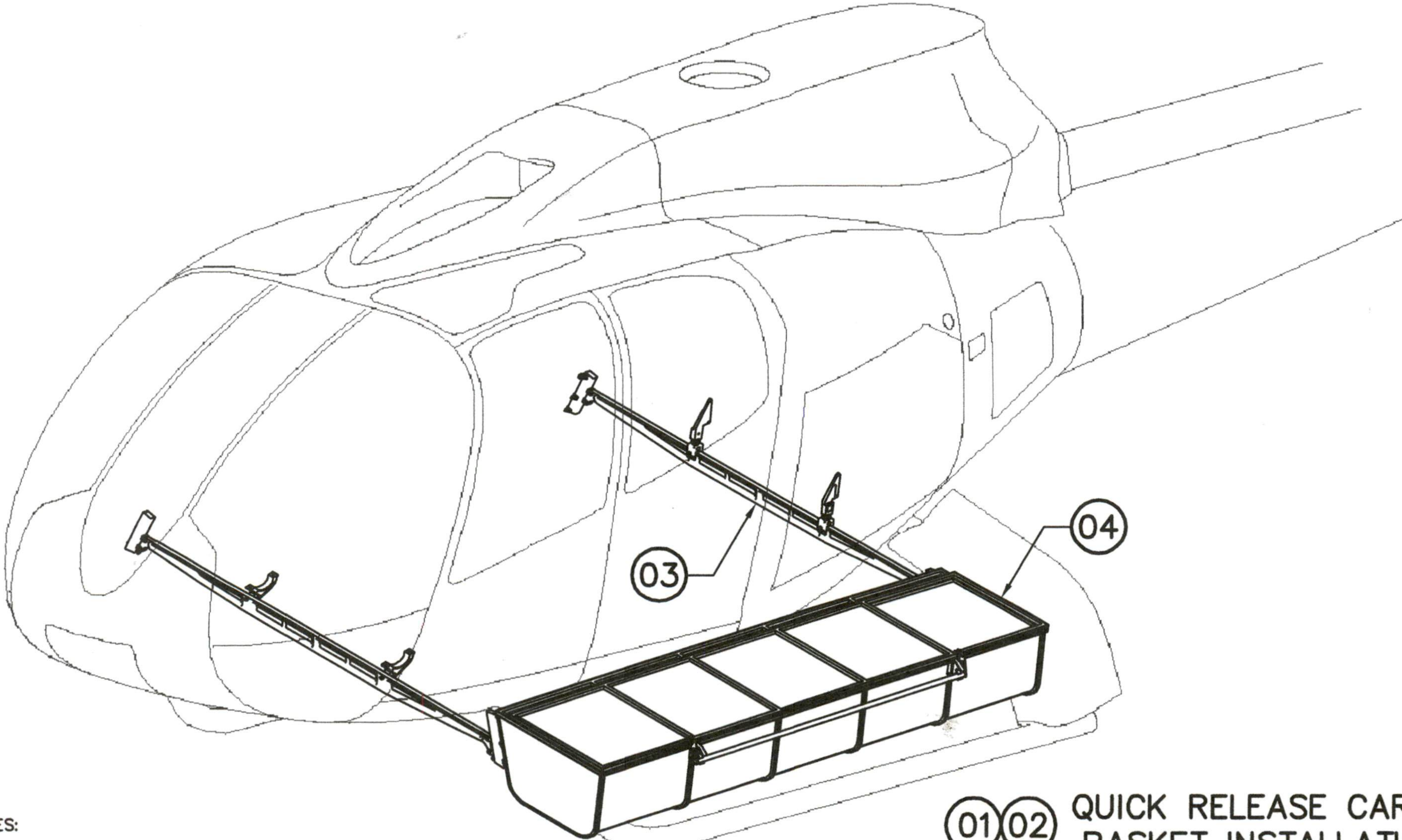


Figure 5.6.3 – Helicopter Reactions, Drag Load



01 02 QUICK RELEASE CARGO BASKET INSTALLATION

LH SHOWN, RH OPPOSITE

NOTES:

1. REFER TO ICA1009.91 FOR WEIGHT AND BALANCE INFORMATION.
2. INSTALLATION INSTRUCTIONS:
   A. ENGAGE UPPER AFT ATTACHMENT FITTING INTO HOOK ON AFT MOUNTING BEAM.
   B. RAISE BASKET AND ENGAGE LOWER AFT ATTACHMENT FITTING IN SLOT.
   C. SLIDE BASKET AFT AND INSERT FORWARD ATTACHMENTS INTO FORWARD BEAM KEYWAYS.
   D. PUSH FORWARD END DOWN TO LOCK. PULL UP TO CHECK.

1	1	100910-01	04	CARGO BASKET ASSEMBLY
1	1	100902-01	03	QUICK RELEASE MOUNTING BEAMS INSTALLATION
		100901-01-02	02	RH QUICK RELEASE CARGO BASKET INSTALLATION
		100901-01-01	01	LH QUICK RELEASE CARGO BASKET INSTALLATION
02	01	PART NO.	ITEM	DESCRIPTION
QTY	QTY			LIST OF MATERIALS

APPROVALS		DATE
DRAWN:	JEFF CLARKE	02 JUNE 2015
CHECKED:	JASON REKVE	03 JUNE 2015

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON:

DECIMALS		ANGLES
X.XXX	±0.010	±1/2°
X.XX	±0.03	
X.X	±0.1	

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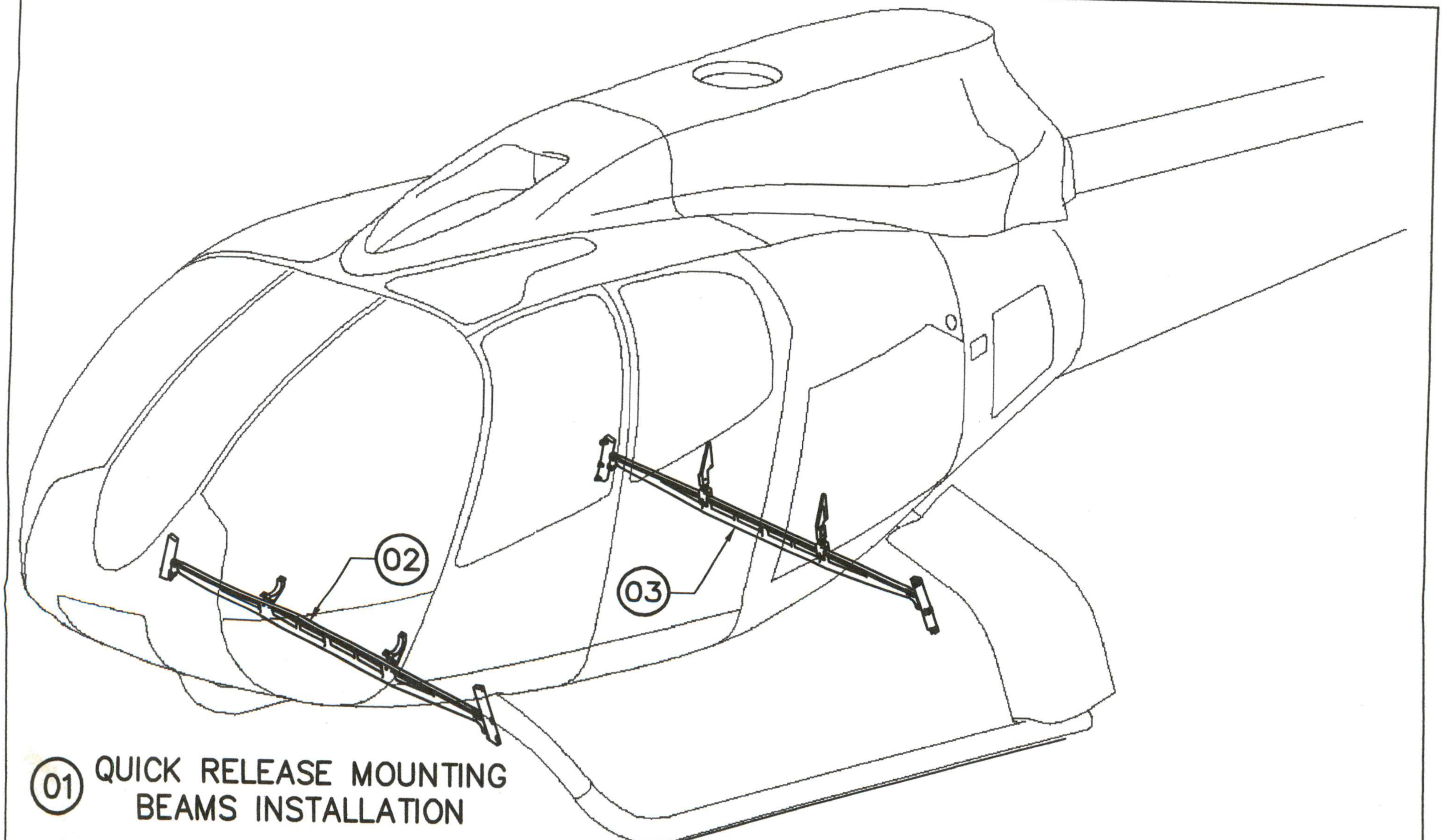
AIRBUS HELICOPTERS EC130 B4
QUICK RELEASE CARGO BASKET
CARGO BASKET INSTALLATION

NOT TO SCALE	DWG. SIZE	DWG. NO.	REV.
SHEET 1 OF 1	A4	100901	0



01 QUICK RELEASE MOUNTING BEAMS INSTALLATION

NOTES:

1. REFER TO ICA1009.91 FOR WEIGHT AND BALANCE INFORMATION.

QTY	PART NO.	ITEM	DESCRIPTION
1	100902-21	03	AFT BEAM INSTALLATION (SHT. 3)
1	100902-11	02	FORWARD BEAM INSTALLATION (SHT. 2)
	100902-01	01	QUICK RELEASE MOUNTING BEAMS INSTALLATION
01	PART NO.	ITEM	DESCRIPTION
QTY	LIST OF MATERIALS		

APPROVALS		DATE
DRAWN:	JEFF CLARKE	25 MAY 2015
CHECKED:	JASON REKVE	29 MAY 2015

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TOLERANCES ON:

DECIMALS		ANGLES
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X.XX	±0.03	
X.X	±0.1	

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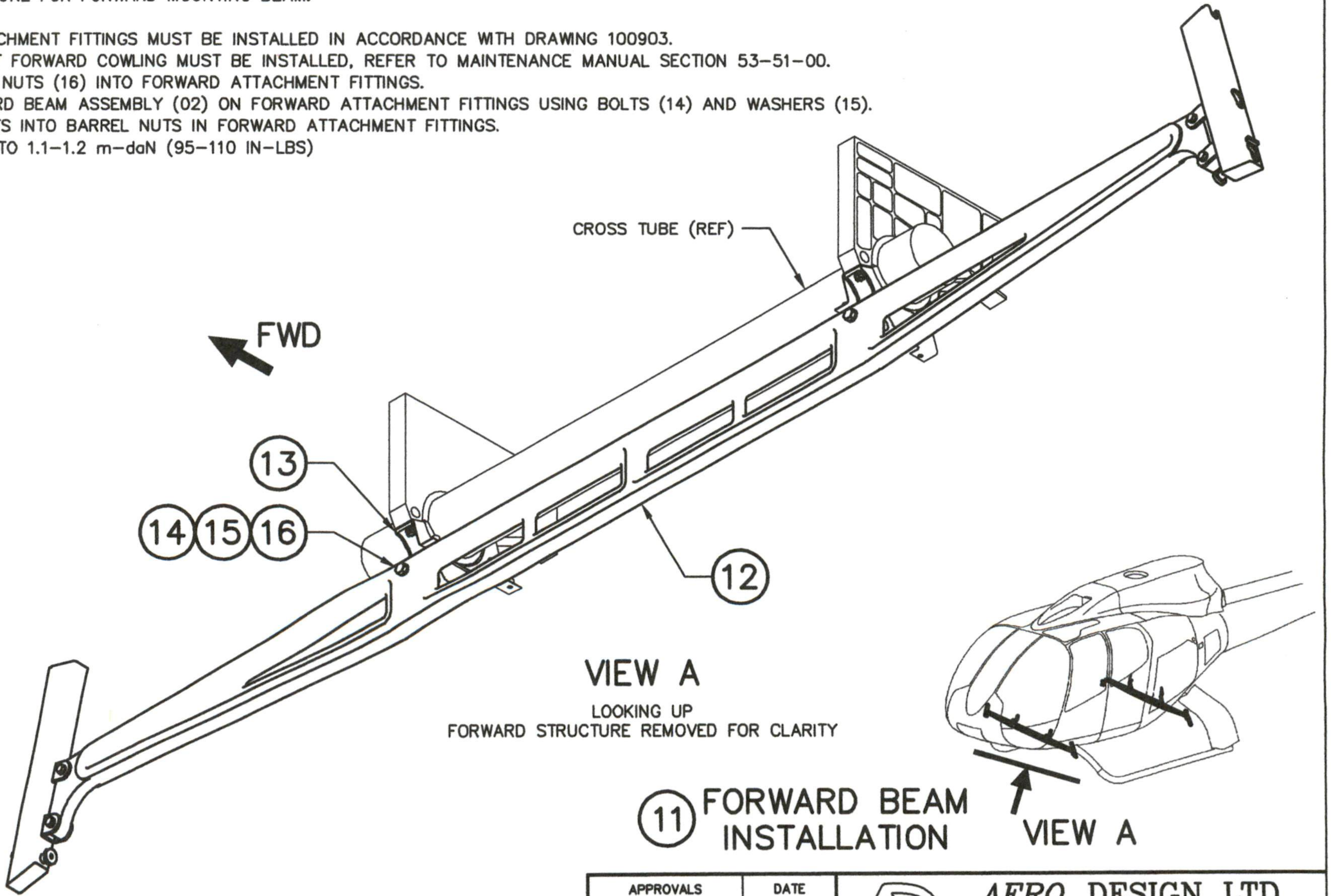
AIRBUS HELICOPTERS EC130 B4
QUICK RELEASE MOUNTING PROVISIONS
QUICK RELEASE MOUNTING BEAMS INSTALLATION

NOT TO SCALE	DWG. SIZE	DWG. NO.	REV.
SHEET 1 OF 3	A4	100902	0

INSTALLATION PROCEDURE FOR FORWARD MOUNTING BEAM:

1. EXTERNAL ATTACHMENT FITTINGS MUST BE INSTALLED IN ACCORDANCE WITH DRAWING 100903.
2. LEFT AND RIGHT FORWARD COWLING MUST BE INSTALLED, REFER TO MAINTENANCE MANUAL SECTION 53-51-00.
3. INSERT BARREL NUTS (16) INTO FORWARD ATTACHMENT FITTINGS.
4. INSTALL FORWARD BEAM ASSEMBLY (02) ON FORWARD ATTACHMENT FITTINGS USING BOLTS (14) AND WASHERS (15). THREAD BOLTS INTO BARREL NUTS IN FORWARD ATTACHMENT FITTINGS.
5. TORQUE BOLTS TO 1.1-1.2 m-daN (95-110 IN-LBS)



VIEW A

LOOKING UP
FORWARD STRUCTURE REMOVED FOR CLARITY

11 FORWARD BEAM INSTALLATION

2	49320-01	16	BARREL NUT
2	NAS1149F0663P	15	WASHER
2	AN6-20A	14	BOLT
1	100902-11	13	FORWARD ATTACHMENT FITTINGS INSTALLATION
1	100915-01	12	FORWARD BEAM ASSEMBLY
	100903-11	11	FORWARD MOUNTING BEAM INSTALLATION
01	PART NO.	ITEM	DESCRIPTION
QTY	LIST OF MATERIALS		

APPROVALS	DATE
DRAWN: JEFF CLARKE	25 MAY 2015
CHECKED: JASON REKVE	29 MAY 2015

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TOLERANCES ON:

DECIMALS		ANGLES
X.XXX	±0.010	±1/2°
X.XX	±0.03	
X.X	±0.1	

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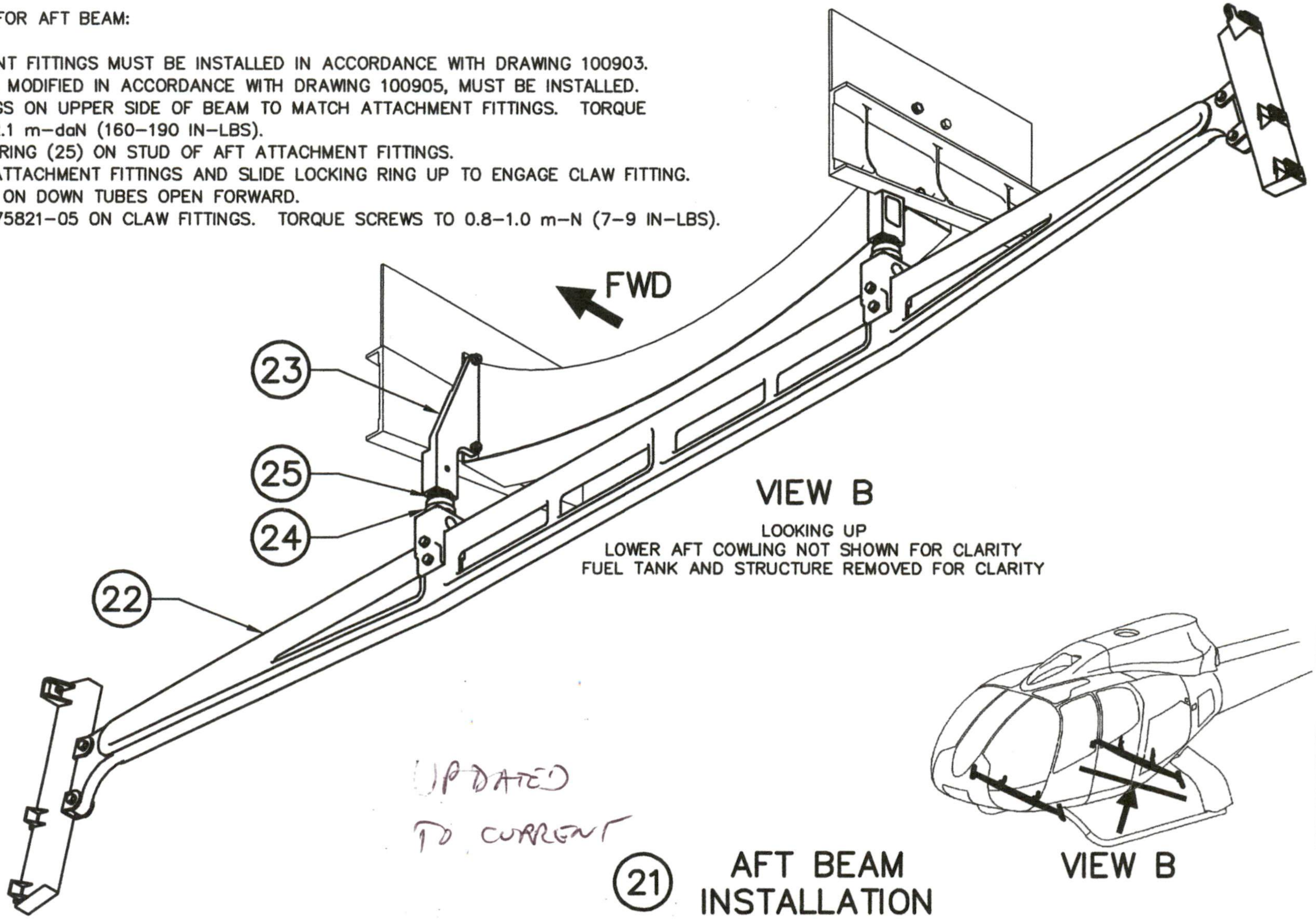
AIRBUS HELICOPTERS EC130 B4
QUICK RELEASE MOUNTING PROVISIONS
QUICK RELEASE MOUNTING BEAMS INSTALLATION

NOT TO SCALE	DWG. SIZE	DWG. NO.	REV.
SHEET 2 OF 3	A4	100902	0

INSTALLATION PROCEDURE FOR AFT BEAM:

1. EXTERNAL ATTACHMENT FITTINGS MUST BE INSTALLED IN ACCORDANCE WITH DRAWING 100903.
2. LOWER AFT COWLING, MODIFIED IN ACCORDANCE WITH DRAWING 100905, MUST BE INSTALLED.
3. LOCATE CLAW FITTINGS ON UPPER SIDE OF BEAM TO MATCH ATTACHMENT FITTINGS. TORQUE FITTINGS TO 1.8–2.1 m–daN (160–190 IN–LBS).
4. INSTALL ELASTOMER RING (25) ON STUD OF AFT ATTACHMENT FITTINGS.
5. PUSH BEAM UP TO ATTACHMENT FITTINGS AND SLIDE LOCKING RING UP TO ENGAGE CLAW FITTING. ENSURE KEYWAYS ON DOWN TUBES OPEN FORWARD.
6. INSTALL LOCK RING 75821–05 ON CLAW FITTINGS. TORQUE SCREWS TO 0.8–1.0 m–N (7–9 IN–LBS).



VIEW B

LOOKING UP
LOWER AFT COWLING NOT SHOWN FOR CLARITY
FUEL TANK AND STRUCTURE REMOVED FOR CLARITY

UPDATED TO CURRENT

VIEW B

21 AFT BEAM INSTALLATION

QTY	PART NO.	ITEM	DESCRIPTION
2	369D21012	25	ELASTOMER RING
2	75821–05	24	LOCK RING ASSEMBLY
1	100903–21	23	AFT ATTACHMENT FITTINGS INSTALLATION
1	100916–01	22	AFT BEAM ASSEMBLY
	100903–21	21	AFT ATTACHMENT FITTINGS INSTALLATION
01	PART NO.	ITEM	DESCRIPTION
QTY			LIST OF MATERIALS

APPROVALS	DATE
DRAWN: JEFF CLARKE	25 MAY 2015
CHECKED: JASON REKVE	29 MAY 2015

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TOLERANCES ON:
DECIMALS X.XXX ±0.010, X.XX ±0.03, X.X ±0.1
ANGLES ±1/2°

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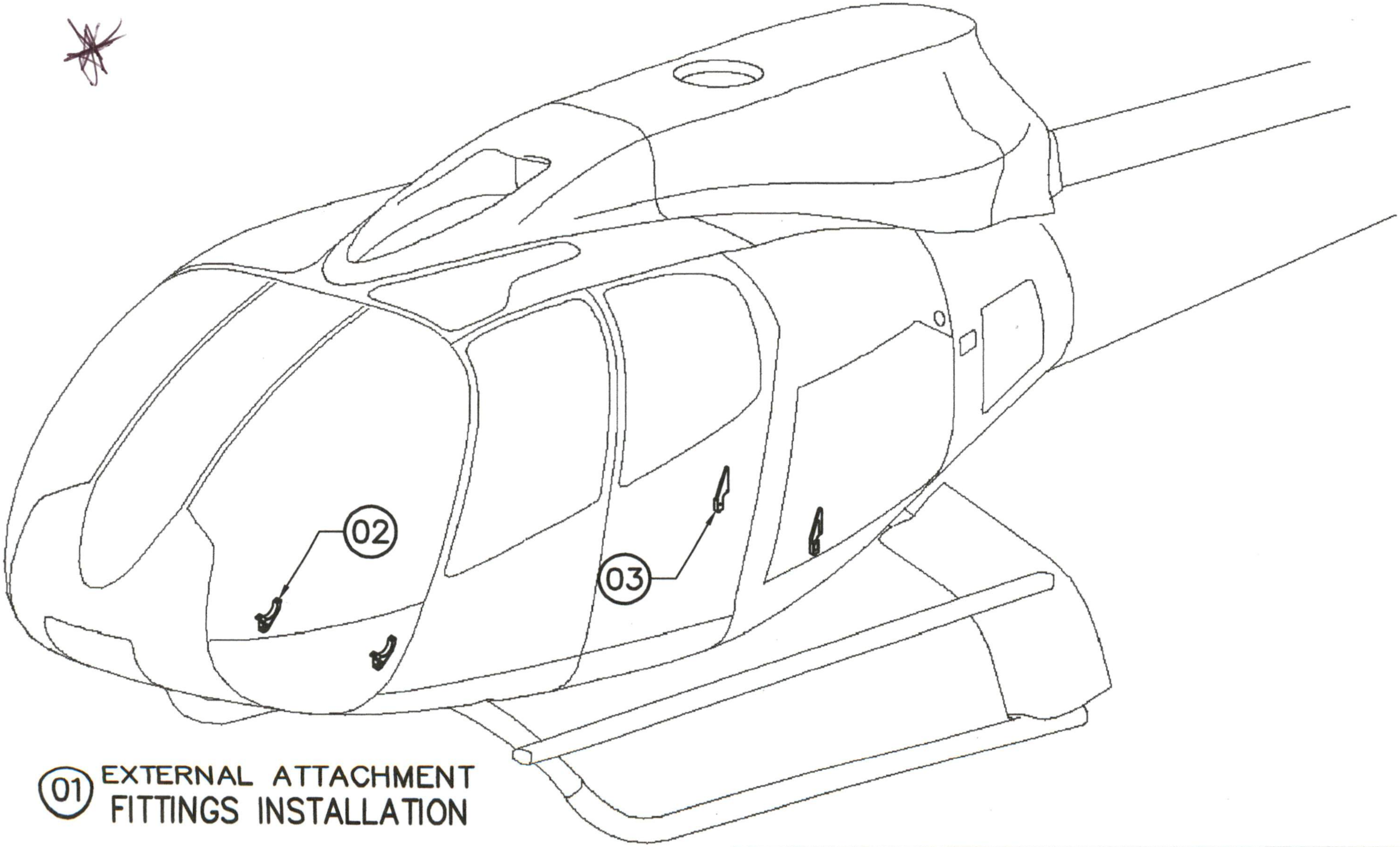
AIRBUS HELICOPTERS EC130 B4
QUICK RELEASE MOUNTING PROVISIONS
QUICK RELEASE MOUNTING BEAMS INSTALLATION

NOT TO SCALE	DWG. SIZE	DWG. NO.	REV.
SHEET 3 OF 3	A4	100902	0



(01) EXTERNAL ATTACHMENT FITTINGS INSTALLATION

NOTES:

1. REFER TO ICA1009.01 FOR WEIGHT AND BALANCE INFORMATION.

1	100903-21	03	AFT FITTINGS INSTALLATION (SHT. 3)
1	100903-11	02	FORWARD FITTINGS INSTALLATION (SHT. 2)
	100903-01	01	EXTERNAL ATTACHMENT FITTINGS INSTALLATION
01	PART NO.	ITEM	DESCRIPTION
QTY	LIST OF MATERIALS		

APPROVALS		DATE
DRAWN:	JEFF CLARKE	22 MAY 2015
CHECKED:	JASON REKVE	25 MAY 2015

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TOLERANCES ON:

DECIMALS		ANGLES
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X.XX	±0.03	
X.X	±0.1	

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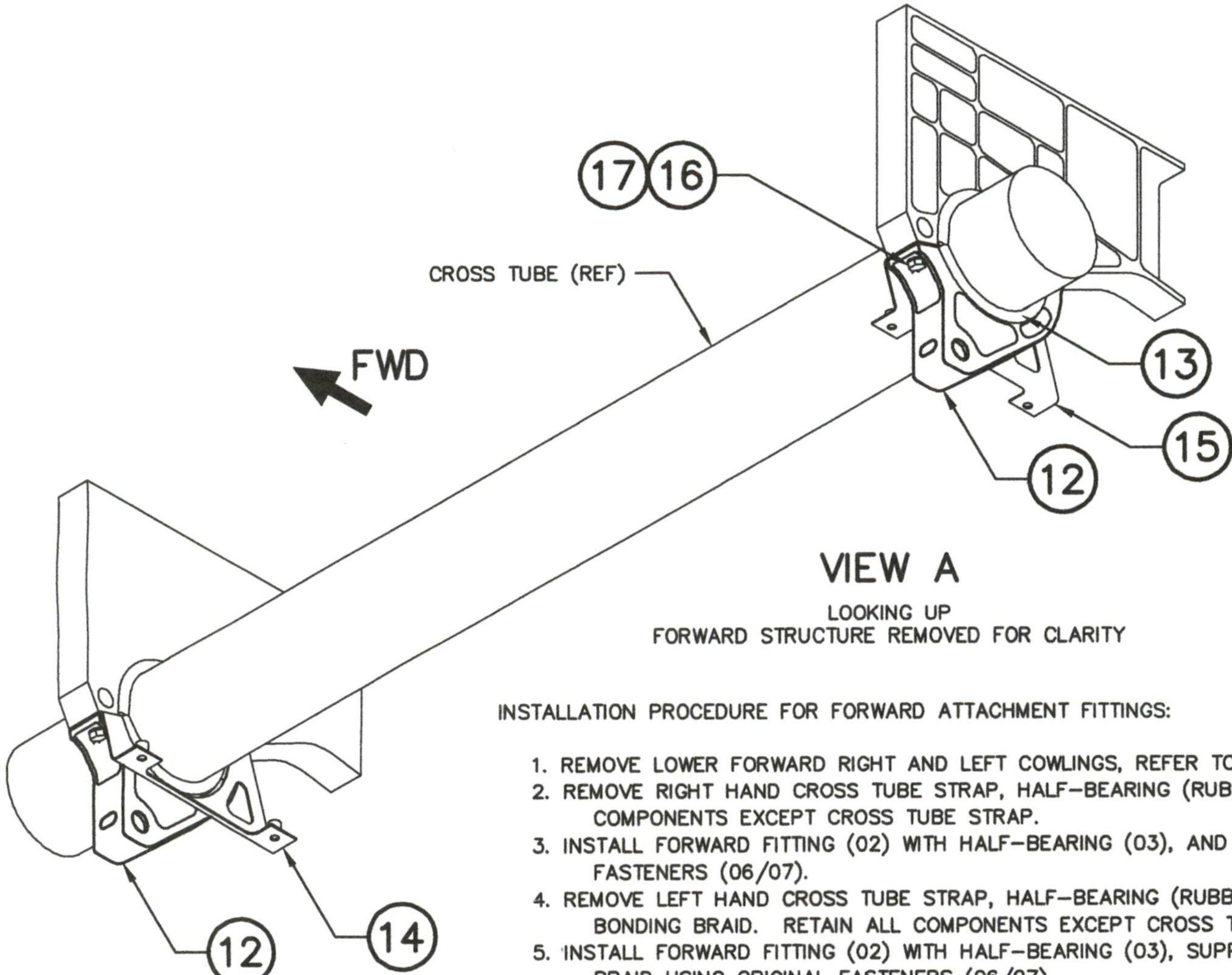
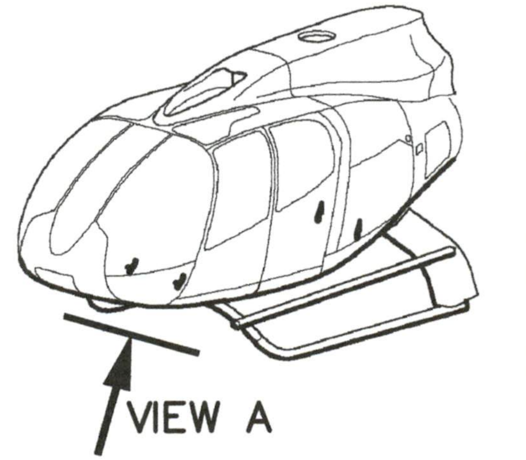
AIRBUS HELICOPTERS EC130 B4
QUICK RELEASE MOUNTING PROVISIONS
EXTERNAL ATTACHMENT FITTINGS INSTALLATION

NOT TO SCALE	DWG. SIZE	DWG. NO.	REV.
SHEET 1 OF 3	A4	100903	0





11 FORWARD ATTACHMENT FITTINGS INSTALLATION

VIEW A

LOOKING UP
FORWARD STRUCTURE REMOVED FOR CLARITY

INSTALLATION PROCEDURE FOR FORWARD ATTACHMENT FITTINGS:

1. REMOVE LOWER FORWARD RIGHT AND LEFT COWLINGS, REFER TO MAINTENANCE MANUAL SECTION 53-51-00.
2. REMOVE RIGHT HAND CROSS TUBE STRAP, HALF-BEARING (RUBBER), AND SUPPORT BRACKET. RETAIN ALL COMPONENTS EXCEPT CROSS TUBE STRAP.
3. INSTALL FORWARD FITTING (02) WITH HALF-BEARING (03), AND SUPPORT BRACKET (04) USING ORIGINAL FASTENERS (06/07).
4. REMOVE LEFT HAND CROSS TUBE STRAP, HALF-BEARING (RUBBER), SUPPORT BRACKET AND ELECTRICAL BONDING BRAID. RETAIN ALL COMPONENTS EXCEPT CROSS TUBE STRAP.
5. INSTALL FORWARD FITTING (02) WITH HALF-BEARING (03), SUPPORT BRACKET (05) AND ELECTRICAL BONDING BRAID USING ORIGINAL FASTENERS (06/07).
6. TORQUE BOLTS TO 2.3-2.7 m-daN (17-20 FT-LBS)
7. INSTALL LOWER FORWARD RIGHT AND LEFT COWLINGS, REFER TO MAINTENANCE MANUAL SECTION 53-51-00.

2*	23111AG080LE	17	WASHER (*RETAINED)
4*	22201BE080016L	16	BOLT (*RETAINED)
1*	350A21-4058-01	15	SUPPORT BRACKET (*RETAINED)
1*	350A21-4058-00	14	SUPPORT BRACKET (*RETAINED)
2*	350A41-0054-20	13	HALF-BEARING, FORWARD, LOWER (*RETAINED)
2	100930-01	12	FORWARD FITTING
	100903-11	11	FORWARD ATTACHMENT FITTINGS INSTALLATION
01	PART NO.	ITEM	DESCRIPTION
QTY	LIST OF MATERIALS		

APPROVALS		DATE
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CHECKED:	JASON REKVE	25 MAY 2015

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X.X	±0.1	

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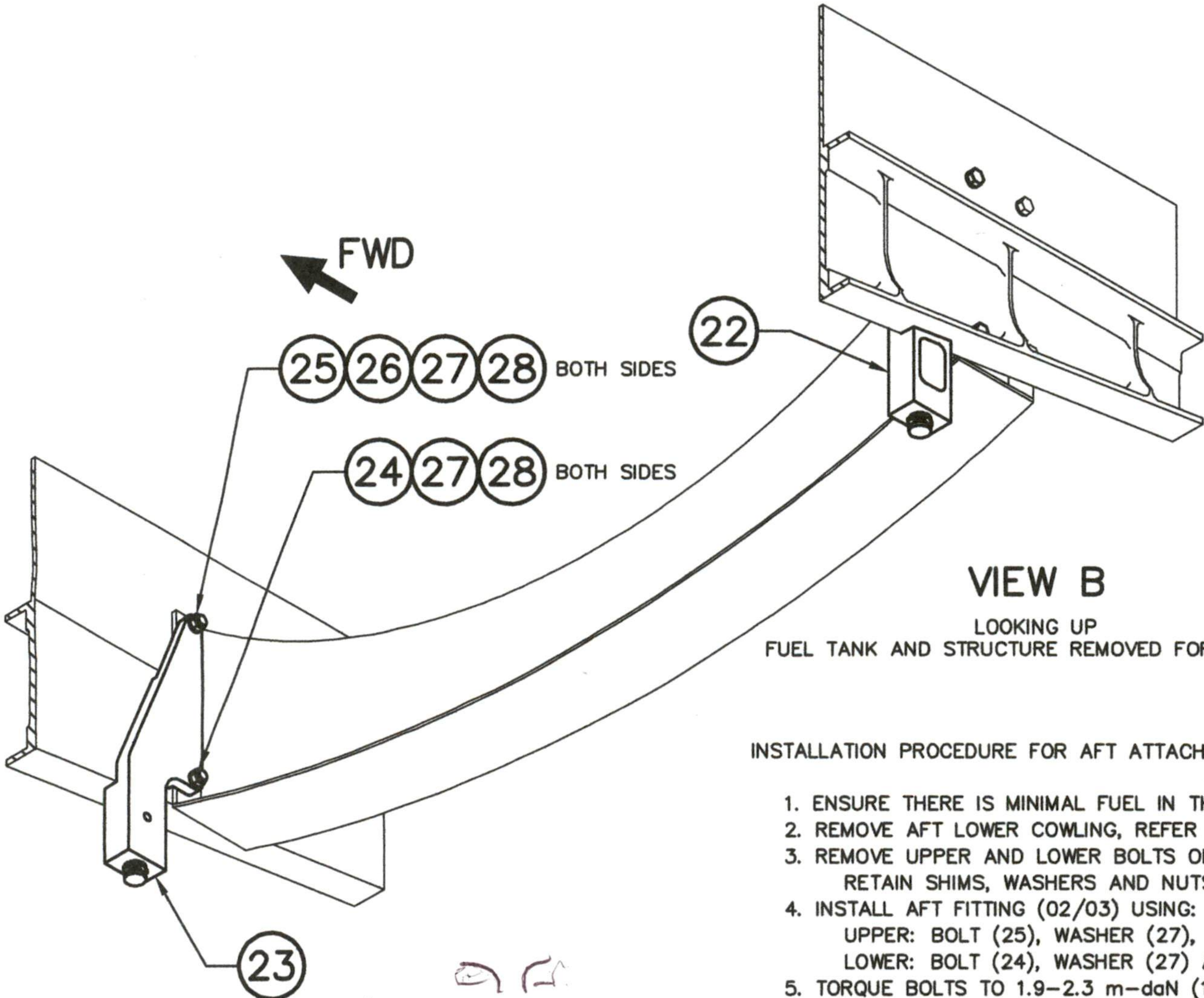
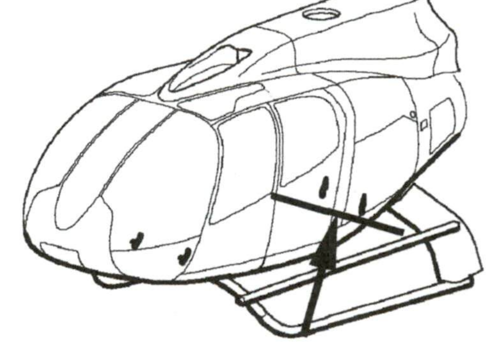
AIRBUS HELICOPTERS EC130 B4
QUICK RELEASE MOUNTING PROVISIONS
EXTERNAL ATTACHMENT FITTINGS INSTALLATION

NOT TO SCALE	DWG. SIZE	DWG. NO.	REV.
SHEET 2 OF 3	A4	100903	0



VIEW B

LOOKING UP
FUEL TANK AND STRUCTURE REMOVED FOR CLARITY



VIEW B

21 AFT FITTINGS INSTALLATION

INSTALLATION PROCEDURE FOR AFT ATTACHMENT FITTINGS:

1. ENSURE THERE IS MINIMAL FUEL IN THE FUEL TANK.
2. REMOVE AFT LOWER COWLING, REFER TO MAINTENANCE MANUAL SECTION 53-51-00.
3. REMOVE UPPER AND LOWER BOLTS ON FORWARD SIDE OF AFT FUEL TANK CROSS MEMBER. RETAIN SHIMS, WASHERS AND NUTS.
4. INSTALL AFT FITTING (02/03) USING:
   UPPER: BOLT (25), WASHER (27), SHIM (26) AND NUT (28)
   LOWER: BOLT (24), WASHER (27) AND NUT (28)
5. TORQUE BOLTS TO 1.9-2.3 m-daN (14-17 FT-LBS)
6. INSTALL AFT LOWER COWLING, REFER TO MAINTENANCE MANUAL SECTION 53-51-00.

23112 washer under head of bolt

QTY	PART NO.	ITEM	DESCRIPTION
4*	ASN52320BH080N	28	NUT (*RETAINED)
6*	23111AG080LE	27	WASHER (*RETAINED)
2*	350A13-1114-21	26	SHIM (*RETAINED)
2	22201BC080020L	25	BOLT #18 long # w/ washers
2	22201BC080018L	24	BOLT #16 long # w/ washers? TBD
1	100931-02	23	RH AFT FITTING
1	100931-01	22	LH AFT FITTING
	100903-21	21	AFT ATTACHMENT FITTINGS INSTALLATION
01	PART NO.	ITEM	DESCRIPTION
QTY	LIST OF MATERIALS		

APPROVALS	DATE
DRAWN: JEFF CLARKE	22 MAY 2015
CHECKED: JASON REKVE	25 MAY 2015

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TOLERANCES ON:
DECIMALS: X.XXX ±0.010, X.XX ±0.03, X.X ±0.1
ANGLES: ±1/2°

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AIRBUS HELICOPTERS EC130 B4
QUICK RELEASE MOUNTING PROVISIONS
EXTERNAL ATTACHMENT FITTINGS INSTALLATION

NOT TO SCALE	DWG. SIZE	DWG. NO.	REV.
SHEET 3 OF 3	A4	100903	0

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DIRECTION TECHNIQUE SUPPORT
13725 MARIGNANE CEDEX FRANCE

CIVIL VERSION(S): B4

SERVICE BULLETIN

No. 25-032

SUBJECT :	EQUIPMENT AND FURNISHINGS
	1160-Kilogram Cargo Swing (Fixed Parts)
Corresponds to MODs OP2914 and OP3630	

LIST OF APPROVED REVISIONS	REVISION No. 0 APPROVED
Not applicable	Date: December 23, 2003

1. PLANNING INFORMATION

1.A. EFFECTIVITY

1.A.1. Helicopters

EC130 version B4 helicopters.

1.A.2. Component(s) affected

Cabin and cargo floor, collective pitch lever, Honeywell unit, canopy and fuel tank cradles.

1.B. ASSOCIATED REQUIREMENTS

Not applicable.

1.C. REASON

The purpose of this Service Bulletin is to install the 1160-kilogram Cargo Swing.

1.D. DESCRIPTION

The modifications consist of:

For the fixed part of the Cargo Swing (OP3630): replacing the existing cradles with reinforced cradles (change of shape of the cradle attachment angles by adding a joggled joint).

For the fixed parts of the Cargo Swing (OP2914), installing:
- The emergency mechanical load release control assembly, comprising a load release trigger grip secured to the pilot's collective pitch lever and a control cable assembly routed under the cabin and cargo floors.
- The "SLING" pushbutton, on the Honeywell control unit.
- The load indicator with its support, on the canopy post to the left side of the pilot.
- The associated electrical wiring.

1.E. COMPLIANCE

Compliance with this Service Bulletin is left to the initiative of the customer.

1.E.1. At the works

1.E.1.a. On aircraft

At customer's request.

1.E.1.b. On spares

On customer's order.

1.E.2. Retrofit action on the operator's site

1.E.2.a. On aircraft

By the operator.

1.E.2.b. On spares

Before installation on aircraft.

1.F. APPROVAL

Approval is limited to civil version helicopters subject to an Airworthiness Certificate.

1.F.1. Approval of the modifications

The information or instructions relate to Aircraft Modification Approval Form (FAM) OP2914 Issue 1, which was approved on May 16, 2001, under the authority of DGAC Design Organisation Approval No. F.JA01.

The information or instructions relate to Aircraft Modification Approval Form (FAM) OP3630 Issue 1, which was approved on January 30, 2001, under the authority of DGAC Design Organisation Approval No. F.JA01.

1.F.2. Approval of the Service Bulletin

The technical information contained in Revision 0 of this Service Bulletin No. 25-032 was approved on December 23, 2003 under the authority of DGAC Design Organisation Approval No. F.JA01.

1.G. MANPOWER

Qualification: 1 Mechanic fitter and 1 Electrician.
Time: Approximately 32 hours.

1.H. WEIGHT AND BALANCE

- Weight: + 5.3 kg.
- Moment / x: + 15.476 m.kg.

1.I. EFFECT ON ELECTRICAL LOADS

No effect.

1.J. SOFTWARE MODIFICATION EMBODIMENT STATE

Not applicable.

1.K. REFERENCES

Aircraft Maintenance Manual (AMM):
Tasks 28-11-00,4-1, 28-11-00,4-2, 25-91-00,5-1, 25-91-00,5-2.

Standard Practices Manual (MTC):
Work Cards 20.07.03.406, 20.02.04.401, 20.06.01.310, 20.06.04.302, 20.05.01.211, 20.05.01.212, 20.02.07.403, 20.07.03.408, 20.07.02.201, 20.08.05.102, 20.02.07.101, 20.02.07.401, 20.02.07.404.

Component Maintenance Manual (CMM): Task 25-89-04.

Flight Manual (FLM): Supplement 9 Chapter 15.

1.L. OTHER DOCUMENTS CONCERNED

Aircraft Maintenance Manual (AMM).
Illustrated Parts Catalog (IPC).
Wiring Diagrams Manual (WDM).
Master Servicing Manual (MSM).

1.M. INTERCHANGEABILITY AND MIXABILITY OF PARTS

1.M.1. Interchangeability

Not applicable.

1.M.2. Mixability

Not applicable.

2. ACCOMPLISHMENT INSTRUCTIONS

2.A. GENERAL

- Comply with the safety instructions applicable to aircraft parked inside a hangar as per MTC Work Card 20.07.02.201.
- Comply with the rules in force applicable for repair and maintenance of aircraft as per MTC Work Card 20.08.05.102.
- Perform electrical bonding as per MTC Work Cards 20.02.07.101 and 20.02.07.401.
- Install rivets as per MTC Work Card 20.02.04.401.
- Install electrical harnesses as per MTC Work Card 20.02.01.415.
- Apply MASTINOX as per MTC Work Card 20.05.01.211.
- Instructions applicable when working on an aircraft electrical power system as per MTC Work Card 20.07.03.406.
- Perform the visual cleanliness appearance checks on an aircraft after an inspection or repair as per MTC Work Card 20.07.03.408.
- Apply PR 1829B2 sealing compound as per MTC Work Card 20.05.01.212.
- Apply VERNELEC 43022 varnish as per MTC Work Card 20.02.07.403.
- Apply SGE BRISAL OX 50855 compound as per MTC Work Card 20.02.07.404.
- Apply BOSTIK 1400 as per MTC Work Card 20.06.01.310.
- Apply sealing mix No. 9 as per MTC Work Card 20.06.04.302.

2.B. OPERATIONAL PROCEDURE

2.B.1. Preliminary steps

- Open the side hold doors.
- Remove the lower fairing.
- Remove the LH pilot's seat.
- Disconnect all electrical power supplies as per MTC Work Card 20.07.03.406.
- Remove the fuel tank as per AMM Task 28-11-00,4-1.

2.B.2. Installation of the fixed parts

2.B.2.a. Installation of the reinforced cradles (OP3630) (Figure 7)

- Remove the forward cradle struts and the fuel tank support cradles.
- Install forward cradle (71) with bolts (73) and (75), washers (72) (1 under head, 1 under nut) and nuts (74) (Detail 2).
- Install aft cradle (76) with bolts (73) and (77), washers (72) (1 under head, 1 under nut) and nuts (74) (Detail 3).
- Attach struts (78) on floor side with bolts (73), washers (82) (1 under head, 1 under nut), nuts (74) and dry torque to 1.9 to 2.3 daN.m (Detail 1).
- Attach struts (78) on cradle side with bolts (80), washers (79) (1 under head, 1 under nut), nuts (81) and dry torque to 0.75 to 0.9 daN.m (Detail 1).
- Reinstall the fuel tank as per AMM Task 28-11-00,4-2.

2.B.2.b. Installation of the Cargo Swing (Fixed Parts) (OP2914) (Figures 1, 2, 3, 4, 5, 6)

- Installation of the emergency mechanical load release control cable assembly (1) on the collective pitch lever (Figure 1):

  - Drill two holes in the cabin floor (Details 1 and 2).
  - Produce the cut-out (A) (Details 2 and 3).
  - Offer up reinforcement plate (3), drill back the cabin floor (Details 1 and 2) and attach with rivets (10) as per MTC Work Card 20.02.04.401.
  - Install grommet (12) with adhesive (22) as per MTC Work Card 20.06.01.310 and cut it (Detail 3).
  - Bond a non-slip strip (20) on the LH collective pitch lever (Detail 4) and on the 2 half-clamps of the load release control (do not install the control reduction bushes).
  - Offer up load release control cable assembly (1) (aligned with the collective pitch lever) and tighten moderately so that the control is secured on the tube of the collective pitch lever (disconnect the load release trigger grip in order to feed the load release control cable assembly through the cabin floor).
  - Feed the load release control cable assembly through the collective pitch lever boot.

- Between X 1790 and X 2700 (Figures 1, 2)
  - Route the load release control cable assembly parallel with the aircraft centerline using the P2 line as a support.
  - Drill one hole to a diameter of 24 mm (Figure 2 Detail 1) in frame X 1790 and fit grommet (17).
  - In the position shown (X 2700, Y -400) (Figure 2 Detail 2), offer up clamp support (4) and drill back the frame as per MTC Work Card 20.02.04.401.
  - Install clamp support (4) with rivets (14).
  - Temporarily install clamp (6) with bolt (7), washers (8) (1 under head, 1 under nut) and nut (9).
  - Protect the load release control cable assembly (between the cabin floor and frame X 1790) with strip (19) and attach one clamp (16) at each end of the strip (Figure 1 Detail 4).
  - Attach clamp supports (15) to the P2 line with clamps (16) (Figure 1) and secure the load release control cable assembly with clamps (16) but do not tighten them.
  - Temporarily install clamp (6) at X 2258 with the existing hardware.

- Aft of X 2700 (Figures 1, 3, and 5)
  - Cut out 2 holes to a diameter of 20 mm, prepare mix (13) as per MTC Work Card 20.06.04.302 and install inserts (31) (Figure 1 Detail 5).
  - Offer up and install support assembly (2) at X 2980 with bolts (11), washers (8) (1 under head, 1 under nut) and nuts (9) (Figure 1 Detail 5).
  - Drill and cut out 6 areas (A) in the lower fairing using drilling and cutting tool (59) (positioned with the fairing attachment screws) (Figure 3).
  - Drill 2 holes (Figure 3 View C-C).

NOTE

Comply with the orientation of clamps (21).

  - Temporarily install 2 clamps (21) with bolts (11), washers (8) (1 under head, 1 under nut) and nuts (9) (Figure 3).
  - Attach load release control cable assembly (1) and tighten the temporarily-installed clamps.

- Installation of gussets (5) for the retraction equipment (Figure 1)

  Using the existing holes, install gussets (5) on both sides of the fuselage (at frame X 5063) with rivets (18) as per MTC Work Card 20.02.04.401, after applying sealant (23) as per MTC Work Card 20.05.01.211.

- Installation of support (32) for connector "32M" (Figure 5 Detail 1)

  Temporarily install bolts (34), washers (35) and nuts (36) on connector support (32) and fit cap assembly (33).

- Installation of contactor "23M" and module "88M" support (Figures 5, 6)

  As per Figure 5 Detail 2 (view looking forward on LH side of 15° fuel tank bulkhead):
  - Drill 4 holes to a diameter of 4.2 mm and deburr.
  - Attach contactor "23M" (29) with bolts (27), washers (26) and nuts (25), after performing electrical bonding as per MTC Work Card 20.02.07.401.
  - Attach module "88M" support (28) with bolts (24), washers (26) and nuts (25), after performing electrical bonding as per MTC Work Card 20.02.07.401.

  As per Figure 6 (Detail A):
  Drill one hole to a diameter of 3.2 mm in the beam on the LH side (view looking inboard) at Y 400, for the attachment of harness (44) ground and temporarily install bolt (54), washer (35) and nut (36).

- Installation of the sling load indicator (Figures 4, 6)

  Cut out an area of 1 cm by 1 cm in the bottom of the black skirt in the corner of the canopy on the LH side for the feed-through of harness (44).

  As per Figure 4:
  - Bond the 3 clamp supports (48) on the canopy (Detail 1).
  - Temporarily attach supports (39, 40, 41) to sling load indicator support box (42).
  - Position the assembly on the canopy as per Detail 2.
  - Mark 4 holes to match supports (39, 40) and 4 holes to match support (41).
  - Remove the temporary attachments and drill back the 8 holes to match their respective support as per MTC Work Card 20.02.04.401.
  - Apply sealant (46) as per MTC Work Card 20.05.01.212 and attach the supports with rivets (47).
  - Attach sling load indicator support box (42) on the 2 supports (39, 40) with screws (43) and washers (8) (Detail 2) after performing electrical bonding as per MTC Work Card 20.02.07.401.
  - Attach sling load indicator support box (42) on support (41) with screws (45) (Detail 3) after performing electrical bonding as per MTC Work Card 20.02.07.401.
  - Drill hole A to a diameter of 4.1 mm as per Detail 4, then cut out to a diameter of 28 mm.
  - Offer up reinforcement plate (55) on the structure and drill back the 8 holes as per MTC Work Card 20.02.04.401.
  - Attach the plate with rivets (56) after performing electrical bonding as per MTC Work Card 20.02.07.401 and fit grommet (17).
  - Install sling load indicator (49) in sling load indicator support box (42) with screws (51) and attach bridge (50) with the same screws (Detail 5).

As per Figure 6:
- Shrink sheaths (30) on the output wires of bridge (50).
- Fit sheath (53) over the wires of bridge (50) and shrink extensions (69) on the bridge outputs and shrink sheath (53).
- Crimp and plug-in contacts (52) and connector (70).

- Installation of the sling pushbutton on the Honeywell control unit (Figure 6)

Remove the "SLING" pushbutton and replace it with the assembly comprising pushbutton body (60), lamps (61), light (62) and label (63) or (64) according to version.

- Installation of the electrical harness (Figure 6)

- Install and route (Figure 6) electrical harness (44) along the canopy and the existing harnesses (route 1BAO).
- Attach it with clamps (67), (68).
- Connect the following free ends:

- 1011N-1 : cable 1ME90NE at terminal H	Destination 30M-P1 / A
- 1011N-1 : cable 1ME143NE at terminal J	Destination 1030N-1
- 1011N-1 : cable 1ME115NE at terminal J	Destination 30M1-J1 / 2
- 1031N-1 : cable 1ME93NE at terminal B	Destination 1011N-1
- 1031N-1 : cable 1ME4NE at terminal D	Destination shielding 1ME1E (23M)
- 1031N-2 : cable 1ME132NE at terminal C	Destination shielding 1ME94F (23M)
- 1031N-2 : cable 1ME133NE at terminal D	Destination shielding 1ME1E (23M)
- 32ALP E : cable 1ME1E at terminal 3 and 4 splice, G18	Destination 23M / 1 (1ME1E)
- 31ALP A : cable 1ME87E at terminal 3	Destination 30M-P1 / B
- 20ALP C : cable 1ME10E at terminal 2	Destination 23M / 3 (1ME10F)
- 140L : cable 1WW2H at terminal 4K	Destination 30M1-J1 / 1

- Connect the circuit to the corresponding components.
- Tighten all the temporarily-installed hardware and protect with varnish (37) as per MTC Work Card 20.02.07.403.
- Install fuses (66) and (65) (Figure 6).

- Installation of the labels (Figures 1, 3, 4, 5, 6)

- Bond label (57) on the LH side of the console (Figure 1 Detail 4).
- Bond label (58) on the exterior of the lower fairing with a positional tolerance of ± 10 mm (Figure 3).
- Bond label "23M" (103) (Figures 5 and 6).
- Bond label "88M" (103) (Figures 5 and 6).
- Bond labels "30M" and "30M1" (103) (Figures 4 and 6).
- Bond label "32M" (103) (Figures 5 and 6).
- Bond labels "1031N" (103) (Figures 5 and 6).

2.B.3. Functional tests

- Perform the aircraft appearance and cleanliness checks as per MTC Work Card 20.07.03.408.
- Reconnect the electrical power supplies as per MTC Work Card 20.07.03.406.
- Calibrate the sling load indicator as per CMM Task 25-89-04.
- Perform a functional test of the sling installation electrical indicating system as per AMM Task 25-91-00,5-1.
- Adjust the emergency mechanical load release control assembly as per AMM Task 25-91-00,5-2.

2.B.4. Final steps

- Close the side hold doors.
- Install the lower fairings.
- Reinstall the LH pilot's seat.
- Disconnect all the electrical power supplies as per MTC Work Card 20.07.03.406.

2.C. IDENTIFICATION

Record compliance with Revision 0 of this Service Bulletin in the aircraft documents.

Record embodiment of the following modifications in the Aircraft Individual Inspection Log Book (or R.I.C.).
- OP2914 Issue 1.
- OP3630 Issue 1.

2.D. OPERATING AND MAINTENANCE INSTRUCTIONS

2.D.1. Operating instructions

Refer to the Flight Manual (FLM): Supplement 9 Chapter 15.

2.D.2. Maintenance instructions

- Perform a functional test of the load release control assembly every 7 days as per AMM Task 25-91-00,5-1.
- In salt-laden atmosphere, check and lubricate the load release control assembly every 30 months as per CMM Task 25-89-06.
- Check and lubricate the load release control assembly every 3 years as per CMM Task 25-89-06.

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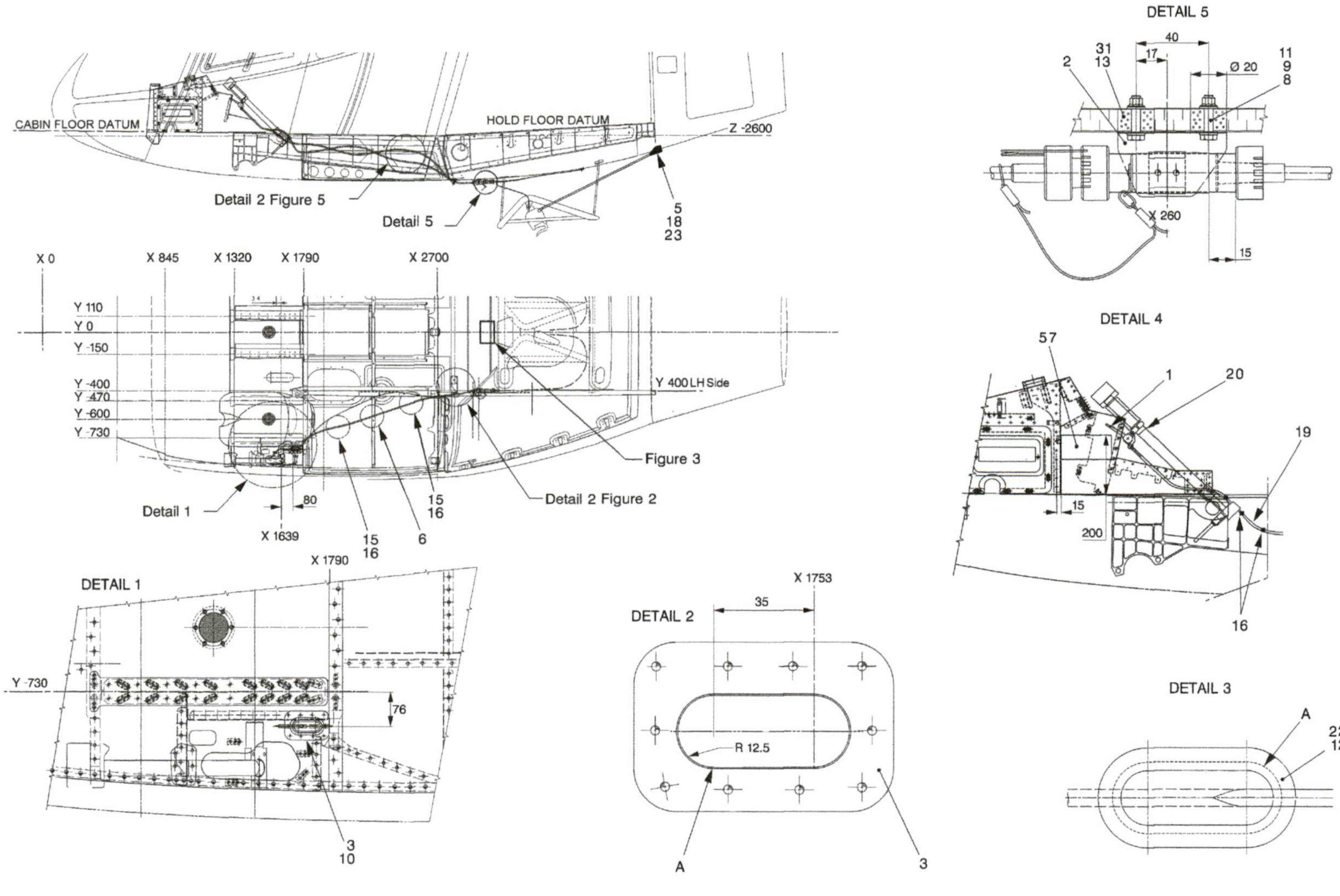
CABIN FLOOR DATUM
HOLD FLOOR DATUM
Z -2600
Detail 2 Figure 5
Detail 5
5
18
23
X 0
X 845
X 1320
X 1790
X 2700
Y 110
Y 0
Y -150
Y -400
Y -470
Y -600
Y -730
Y 400 LH Side
Figure 3
Detail 2 Figure 2
Detail 1
80
X 1639
15
16
6
15
16
X 1790
DETAIL 1
Y -730
76
3
10
DETAIL 2
X 1753
35
R 12.5
A
3
DETAIL 5
40
17
Ø 20
31
13
2
11
9
8
X 260
15
DETAIL 4
57
1
20
19
15
200
16
DETAIL 3
A
22
12

Figure 1

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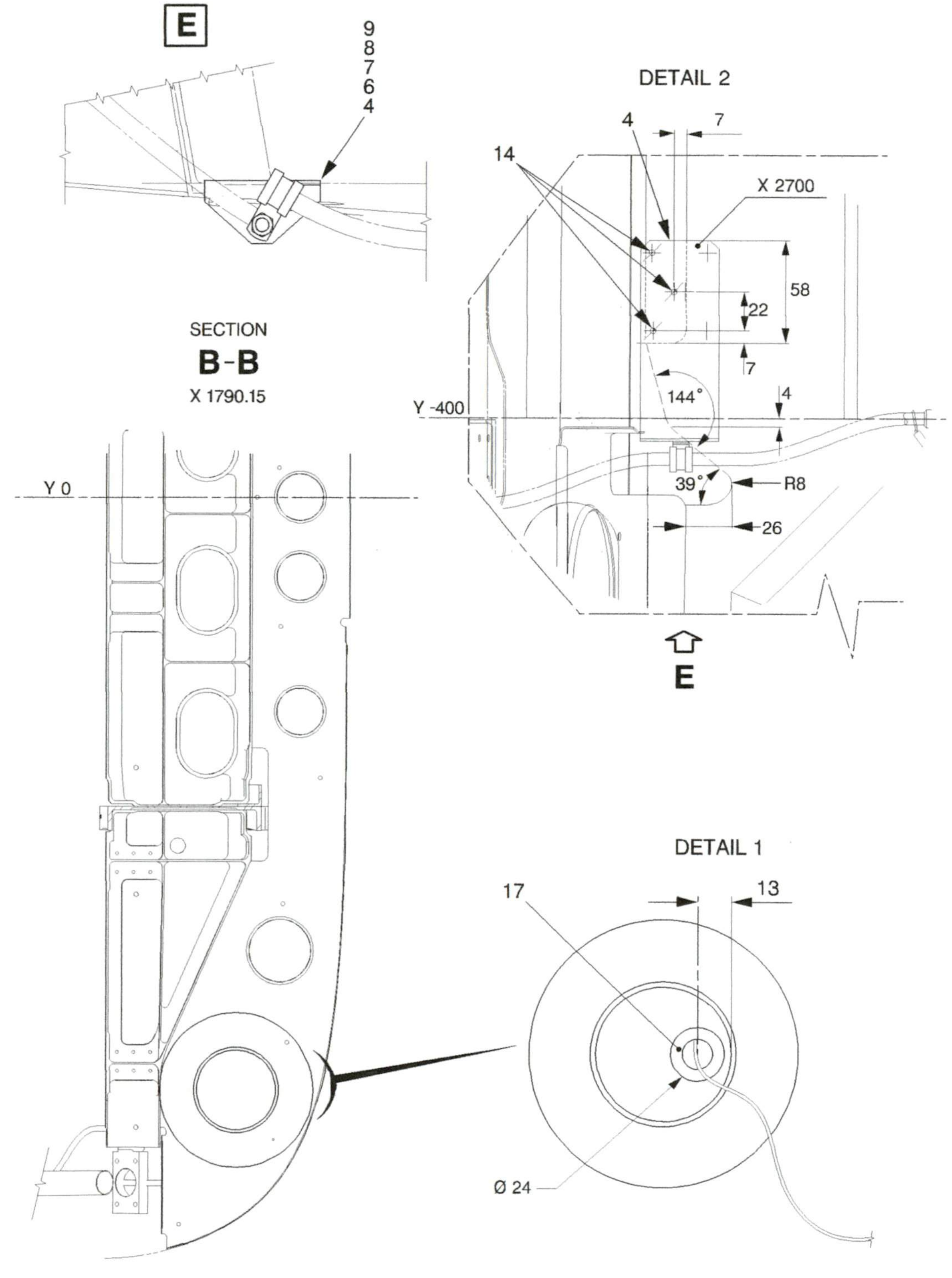
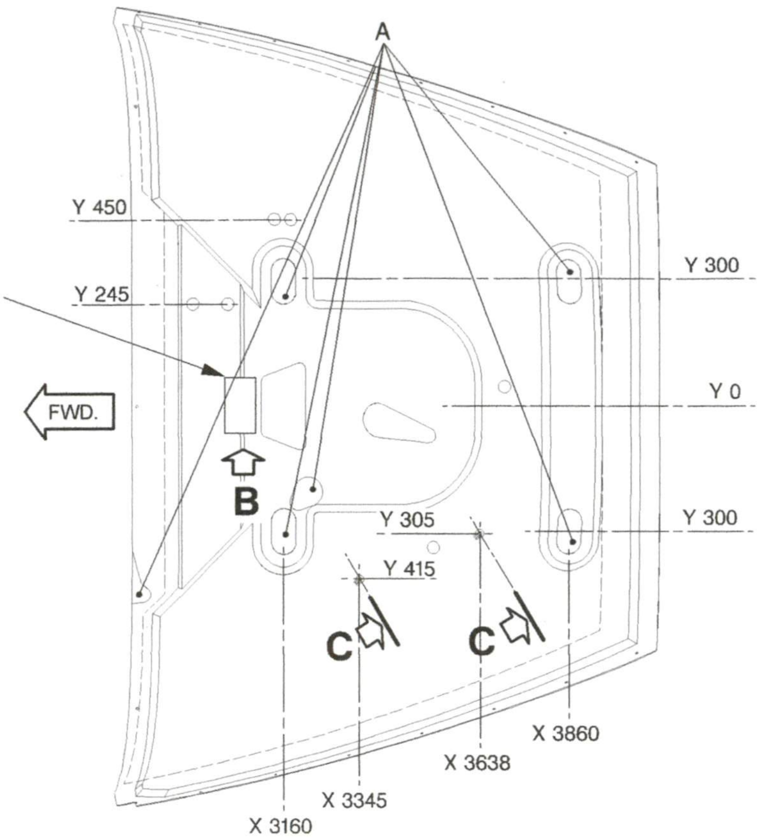
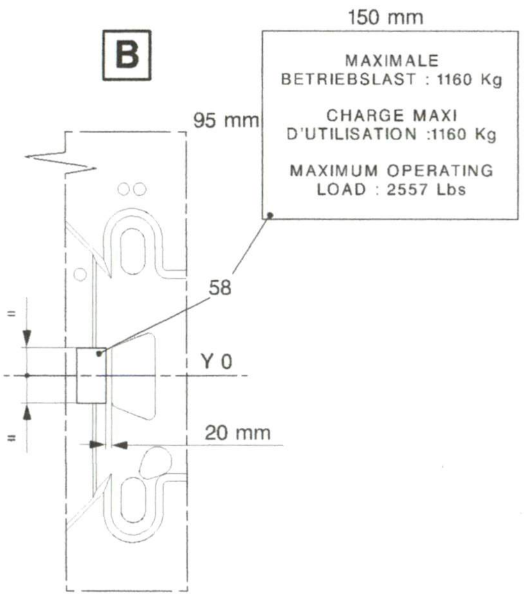

E
9
8
7
6
4
DETAIL 2
4
7
14
X 2700
58
22
7
144°
4
Y -400
39°
R8
26
E
SECTION
B-B
X 1790.15
Y 0
DETAIL 1
17
13
Ø 24

Figure 2


A
Y 450
Y 245
58
FWD.
B
Y 300
Y 0
Y 305
Y 415
Y 300
C
C
X 3860
X 3638
X 3345
X 3160


B
150 mm
95 mm
MAXIMALE
BETRIEBSLAST : 1160 Kg
CHARGE MAXI
D'UTILISATION :1160 Kg
MAXIMUM OPERATING
LOAD : 2557 Lbs
58
=
Y 0
=
20 mm

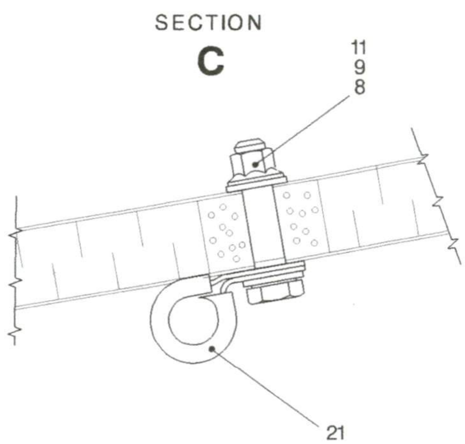

SECTION
C
11
9
8
21

Figure 3

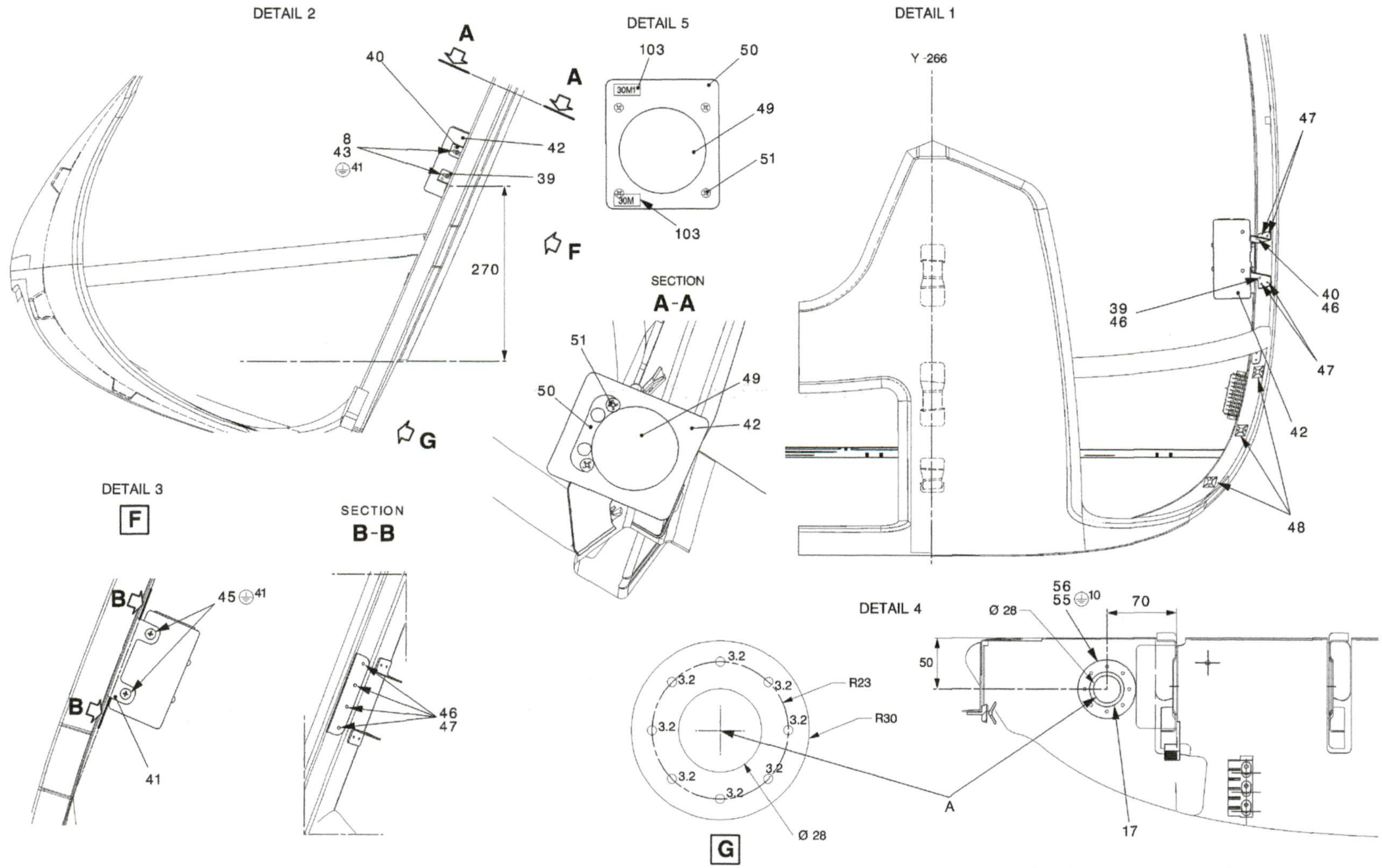

DETAIL 2
A
40
A
8
43
41
42
39
270
F
G
DETAIL 5
103
50
30M1
49
51
30M
103
SECTION
A-A
51
50
49
42
DETAIL 1
Y -266
47
39
46
40
46
47
42
48
DETAIL 3
F
B
45 41
B
41
SECTION
B-B
46
47
DETAIL 4
56
55 10
Ø 28
70
50
3.2
R23
R30
A
Ø 28
17
G

Figure 4

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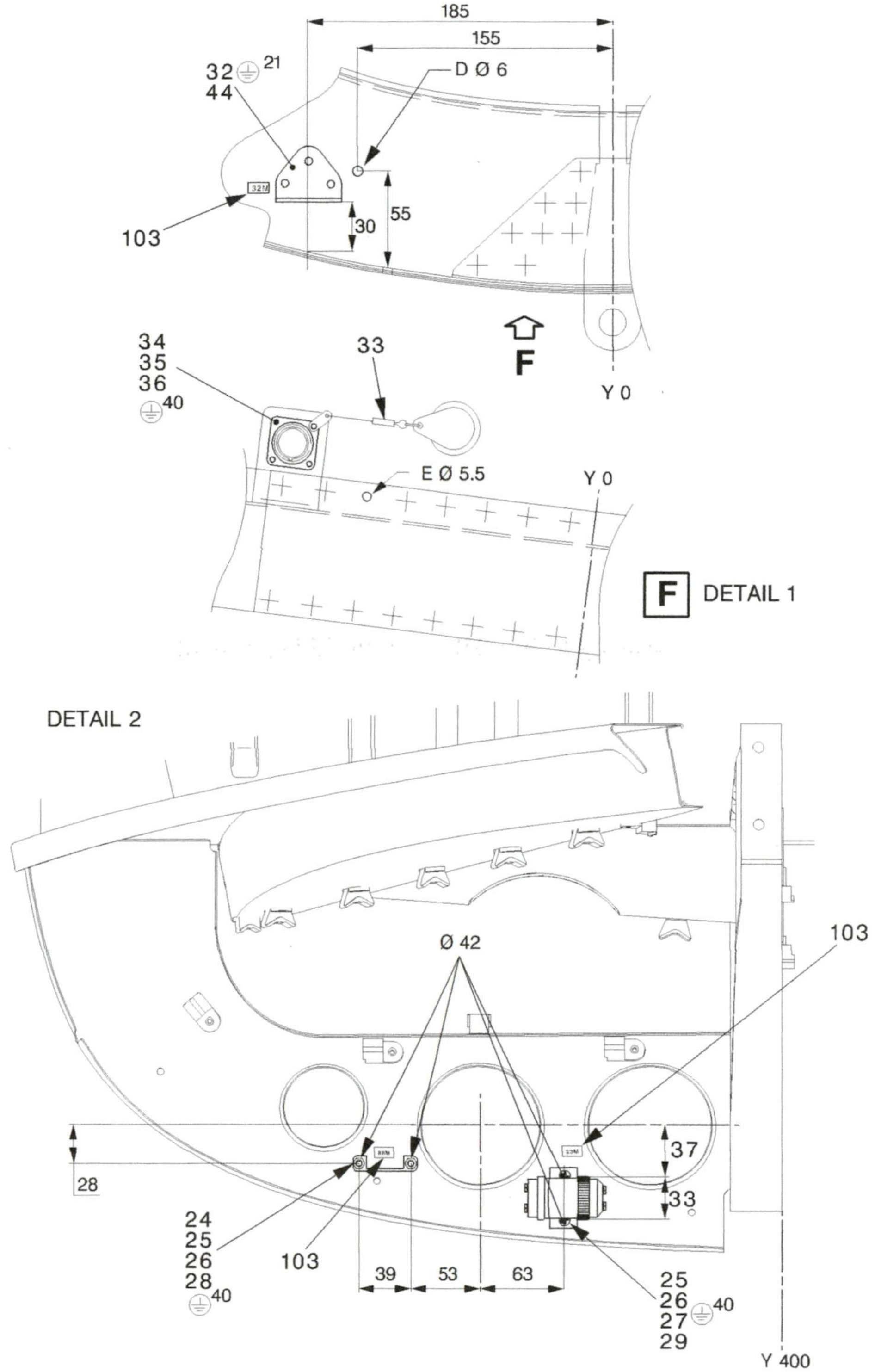
185
155
32
21
44
D Ø 6
103
30
55
34
35
36
40
33
F
Y 0
E Ø 5.5
Y 0
F
DETAIL 1
DETAIL 2
Ø 42
103
37
28
33
24
25
26
28
40
103
39
53
63
25
26
27
29
40
Y 400

Figure 5

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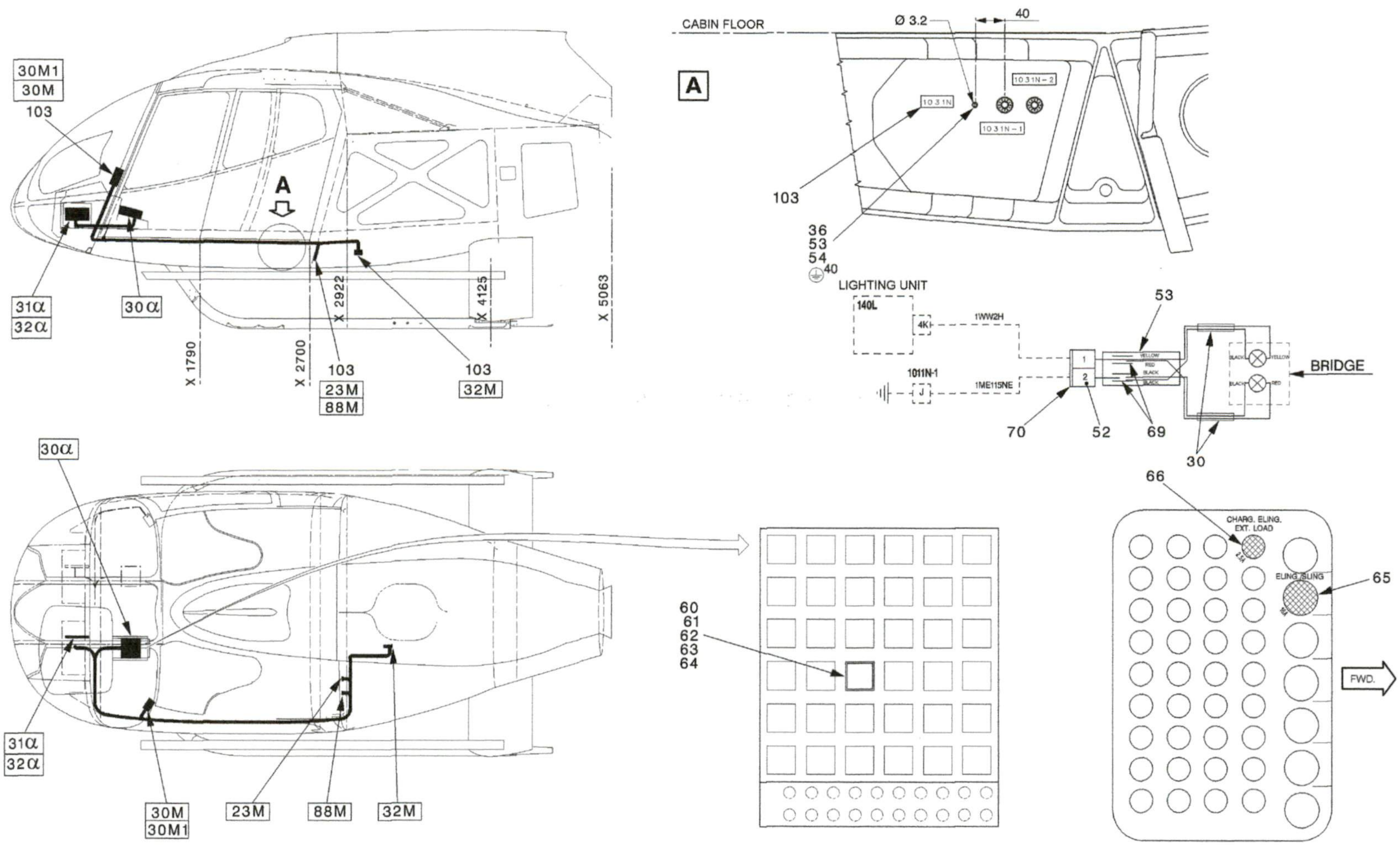
30M1
30M
103
A
31α
32α
30α
X 1790
X 2700
X 2922
103
23M
88M
103
32M
X 4125
X 5063
CABIN FLOOR
Ø 3.2
40
103
36
53
54
40
LIGHTING UNIT
140L
4KI
1WW2H
1011N-1
1ME115NE
53
BRIDGE
70
52
69
30
30α
31α
32α
30M
30M1
23M
88M
32M
60
61
62
63
64
66
CHARG. ELING. EXT. LOAD
65
FWD.

Figure 6

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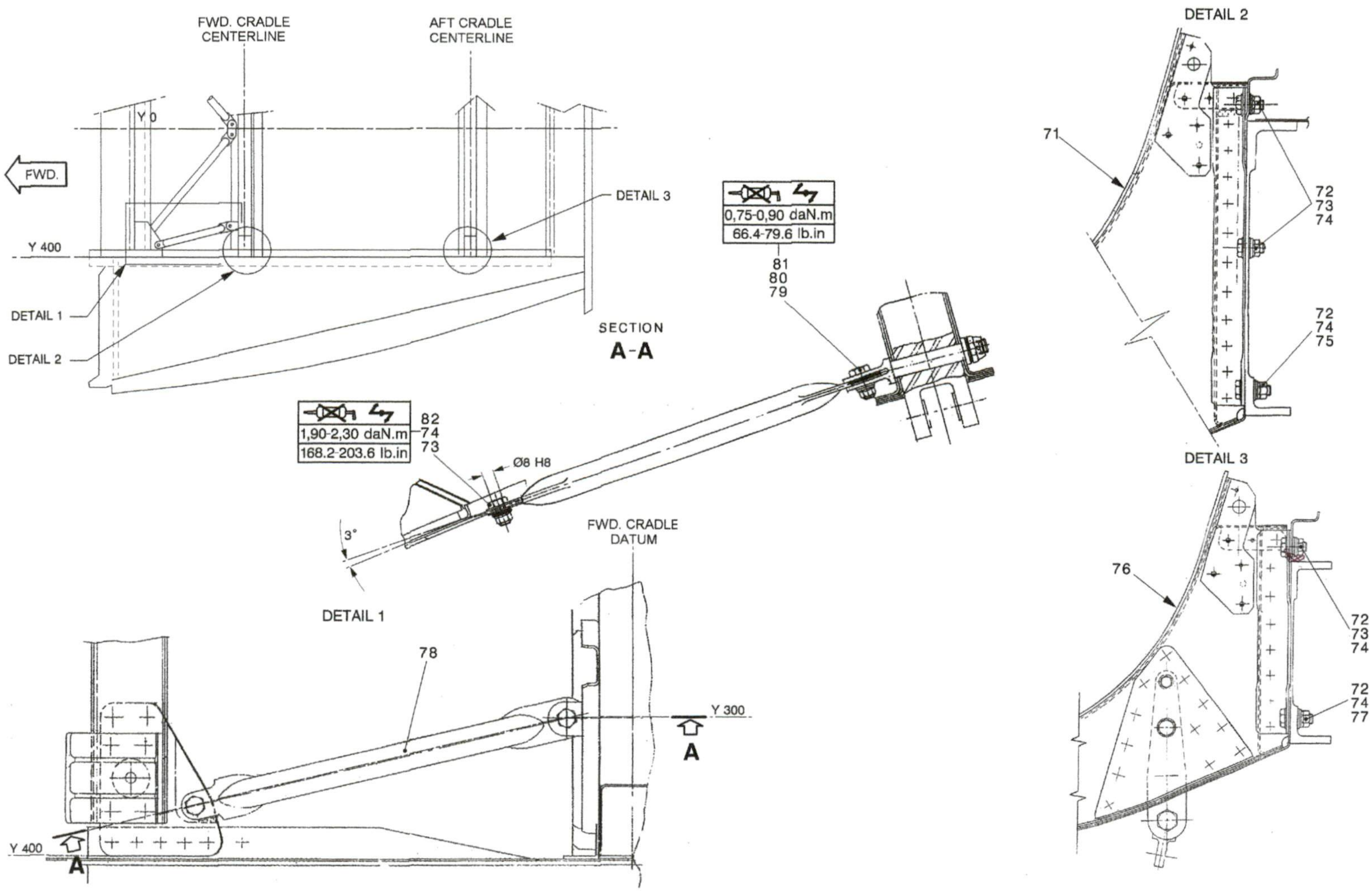

no shim?

Figure 7

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3. MATERIAL INFORMATION

3.A. MATERIAL: COST - AVAILABILITY

For all information, contact the Customer Support Sales Department.

3.B. INFORMATION CONCERNING INDUSTRIAL SUPPORT

Not applicable.

3.C. MATERIAL REQUIRED FOR EACH AIRCRAFT, ENGINE / COMPONENTS

3.C.1. Kit or component(s) to be ordered

3.C.1.a. Cargo Swing (Fixed Parts) OP2914

New P/N (MPN)	Qty	Item	Key Word	Former P/N	Instructions Disposition
350A82-8036-0071			**Kit comprising:**		
AS22-24	1	1	Cable assy, load release control		
350A86-1051-00	1	2	Support assy		
350A86-4000-26	1	3	Plate, reinforcement		
350A86-4000-27	1	4	Support, clamp		
350A86-1043-29	2	5	Gusset, retraction		
ASNA0021-21G06	2	6	Clamp		
22125BC050012L	1	7	Bolt		
23111AG050LE	12	8	Washer		
ASN52320BH050N	5	9	Nut		
21215DC3206J	10	10	Rivet		
22125BC050022L	4	11	Bolt		
DHS751-160.14	1	12	Grommet		
21217AD3210LE	3	14	Rivet		
E0688-02	2	15	Support		
E0043-6C0	6	16	Clamp		
DHS751-160.58	2	17	Grommet		
ASNA0078E404	4	18	Rivet		
84904T075	1m	19	Strip		
DHS285-111.01	1m	20	Strip, non-slip		
C4910	2	21	Clamp		
22208BC040012L	2	24	Bolt, hexagonal head		
ASN52320BH040N	4	25	Lock-nut, hexagonal		
23111AG040LE	4	26	Washer, plain		
22272BC040012L	2	27	Bolt, raised head		
DHS713-125.01	1	28	Support		
100CC01A	1	29	Contactor, unipolar		

New P/N (MPN)	Qty	Item	Key Word	Former P/N	Instructions Disposition
VG95343T05A004A	2m	30	Sheath		
DHS443-700.04	2	31	Insert, HIGRID 55 PCF		
350A63-2517-20	Ref.	32	Support, connector		
341A66-1166-01	1	33	Cap assy		
22272BC030010L	4	34	Bolt		
23111AG030LE	5	35	Washer		
ASN52320BH030N	5	36	Nut		
350A63-2566-02	1	39	Support, bottom		
350A63-2566-03	1	40	Support, top		
350A63-2566-20	1	41	Support		
350A63-3008-00	1	42	Box, support, Sling load indicator		
22208BC050012L	2	43	Screw		
350A63-2513-01AA	1	44	Harness, 1160 kg sling		
A0164TK050S012X	2	45	Screw		
NAS1919C04S02U	8	47	Rivet		
ABM2S-AT-0	3	48	Support		
704A41817010	1	49	Indicator, sling load		
6795703800	1	50	Bridge		
22273CE040018	4	51	Screw		
163088-1	2	52	Contact		
EN6049-003-02-5	2m	53	Sheath		
22272BC030008L	1	54	Bolt		
350A63-3007-20	1	55	Plate, reinforcement		
ASNA0078A402	8	56	Rivet		
DHS811-251.20	1	57	Label		
350A00-0122-62	1	58	Label		
DHS775-160.42	1	60	Body, pushbutton		
EN2240-6839	4	61	Lamp		
DHS775-240.22	1	62	Light		
350A61-1726-51	1	63	Label		
350A61-1726-91	1	64	Label		
HA23-16U	1	65	Fuse		
HA21-2U5	1	66	Fuse		
E0043-2C0	20	67	Clamp		
E0043-3C0	20	68	Clamp		
E0541-12	4	69	Extension		
207845-1	1	70	Connector		
350A63-2567-060	6	103	Labels, set of		

3.C.1.b. Installation of reinforced cradles OP3630

New P/N (MPN)	Qty	Item	Key Word	Former P/N	Instructions Disposition
350A82-8037-0071	lower	upper	**Kit comprising:**		
350A21-1068-05	1	71	Beam assy, fwd, tank support		
23111AG080LE	40	72	Washer		
22201BC080006L	14	73	Bolt		
ASN52320BH080N	22	74	Nut		
22201BC080012L	4	75	Bolt		
350A21-1069-05	1	76	Beam assy, aft, tank support		
22201BC080011L	4	77	Bolt		
350A21-1390-00	2	78	Strut assy, Cargo Swing		
23142AG060LE	2	79	Washer		
22733BC080010M	2	80	Bolt		
ASN52320BH060N	2	81	Nut		
23118AG080LE	2	82	Washer		

3.C.2. Material to be ordered separately

New P/N (MPN)	Qty	Item	Key Word	Former P/N	Instructions Disposition
DHS268-112.20	AR	13	Mix		
DHS171-141.20	AR	22	Adhesive		
MASTINOX 6856 K	AR	23	Mastinox sealant		
VERNELEC43022	AR	37	Varnish		
VASELINE-50855	AR	38	Petrolatum		
ECS6046-1091	AR	46	Sealing compound		

3.C.3. Material delivred by the customer

Not applicable.

3.C.4. Tooling

New P/N	Qty	Item	Key Word	Former P/N	Instructions Disposition
4101S21040300	1	59	Electrical connector marking tool		

3.D. MATERIAL REQUIRED FOR EACH SPARE PART

3.D.1. Kit to be ordered

Not applicable.

3.E. RE-IDENTIFIED PARTS

Not applicable.

3.F. TOOLING: COST - AVAILABILITY

For all information, contact the Customer Support Sales Department.

3.G. PROCUREMENT CONDITIONS

Order the required quantity

from

EUROCOPTER
Etablissement de Marignane
Direction VENTES Service Client
S.V.
13725 MARIGNANE CEDEX
FRANCE

NOTE

On the purchase order, please specify the mode of transport, the destination and the serial numbers of the aircraft to be modified.

4. APPENDIX

Not applicable.

Joining

103. Material identification for screws and nuts

A. PARTS NUMBERS FOR THREADED FASTENERS

Refer to the parts list in the relevant manual (IPC, MRV, etc.) to find the part number of the desired screw or nut.

B. COMPOSITION OF THE PART NUMBER

Example of P/N a screw :

22125	Basic part number
BC	MATERIAL CODE (as per NFL 09-752)
040	Diameter (mm)
020	Length (mm)
L	Surface treatment code (as per NFL 09-753)

In this example, the material code is defined by the letters "BC"

C. MARKING

The two letters defining the material code shall be marked on screw heads whenever possible.

If this is not possible (small screws, nuts) parts may be marked collectively rather than individually. Place screws in sealed bags or string nuts together. Mark the part number on the bags (or on a label inside transparent bags), or on a metal tag attached to the items.

D. IDENTIFICATION CHARTS FOR COMMON MATERIALS

Low-alloy steels

FRENCH AFNOR STANDARD	TENSILE STRENGTH (MPa)	MATERIAL CODE	
15 CDV 6	Rm 1030/1180	BG	
25 CD 4		BB	
25 CD 4S	Rm 640/830	AF	
	Rm 880/1080	BD (1)	
	Rm 1220/1370	BL	
28 CDV 5	Rm 830/980	BJ	
30 NCD 16	Rm 1080/1230	BE	
	Rm 1180/1330	BX	
35 CD 4	Rm 1080/1280	BE	156.6/185.6 ksi
	Rm 1420/1570	BH	
35 CD 4 S		BF	
35 NC 6	Rm 580/670	BA	
	Rm 880/1080	BC	128/157
35 NCD 16	Rm 880/1080	BK	
	Rm 1230/1380	BV	

FRENCH AFNOR STANDARD	TENSILE STRENGTH (MPa)	MATERIAL CODE
E 40 CDV 20	Rm 1550/1800	BS
	Rm $\geq$ 1800	BW
45 S 7 - 45 S 8		BR
45 SCD 6		FJ
100 C 6		KD

(1) BC for nuts with plastic locking rings

(b) Carbon steels

FRENCH AFNOR STANDARD	TENSILE STRENGTH (MPa)	MATERIAL CODE
A 33	Rm 320/390	AA
E 24 (ex A 37)	Rm 360/440	AC
A 50	Rm 490/580	AE
XC 10 - XC 12	Rm 300/450	AD
XC 18 S	Rm 410/490	
XC 32	Rm 550/630	AE
XC 38	Rm 680/840	AF
	Rm 580/670	AG
XC 55		EK
XC 65	Rm $\geq$ 830	AJ
	Rm $\geq$ 1570	AK
XC 75		AM

Jeff Clarke

From: Jim Tinson, Wings Engineering Ltd. [jim@wingsengineering.ca]
Sent: June 25, 2015 4:21 PM
To: 'Jeff Clarke'
Subject: CP1002; Airbus Helicopters EC130B4 and AS350/355 Bike Racks

Hi Jeff,

A few comments wrt to CP1002-0-11May2015 for your consideration.

1. 7.2.2, b,
   Can you please provide an expanded description for the VXP analyzer and plans? i.e.; Honeywell? VXP model number XXX, display, data bucket, using XXX sensor/pick-ups, owner/operators' manual number, used by Airbus ??, pick-up locations iaw ??? Etc.
   and/or ↳ yes
   Note that the applicable test procedure will detail the extent of the VA pass/fail plans which will include running a baseline spectrum for comparison?
   Notes for Airbus spectrum/limits/locations?

Getting this info

2. 7.2.3, a and 7.10
   Please note the aircraft type for the respective FTPs. ✓

3. 7.10, CP1002 Checklists
   Please note Appendix A – AS350/355
   Please include Appendix B – EC130B4
   split to 2

4. Appendix A and as applicable to Appendix B
   27.307 Analysis
   - per ER1002.XX??? Please include the applicable report number for all analysis refernces. ✓

   27.561(c), "Side mounted bike rack/s are not located...."
   - Please add a report reference where the report needs to explain how/why a deflected rack with and without bike/s will not impede egress or penetrate the cabin. ✓

   27.601 Design is conventional? → reworded
   27.787 Bike rack has positive locks?
   - Please add a report reference where the report needs to explain how the locking mechanism works, it's strength wrt to wear, debris, oil, grease and tolerances and ICA instructions wrt maintaining/testing the required clamp-up fit. ✓

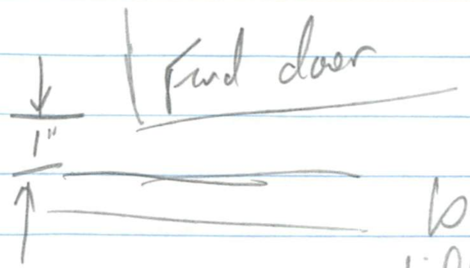
   27.807 Statement in report
   - What report and what report #? ✓

Cheers,

Jim Tinson FEC, PEng, DAR
T/F: 604.274.5647, C: 604.418.8955
WINGSENGINEERING.CA

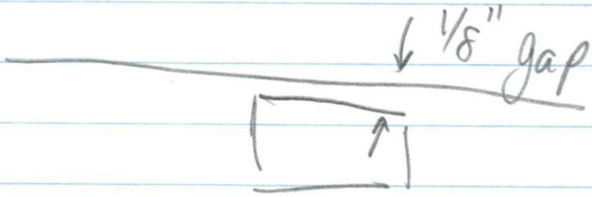
From: Jeff Clarke [mailto:jeff@aerodesign.ca]
Sent: May-15-15 10:54 AM
To: robert.metz@tc.gc.ca
Cc: jorge.canal@tc.gc.ca; 'Jim Tinson, Wings Engineering Ltd.'

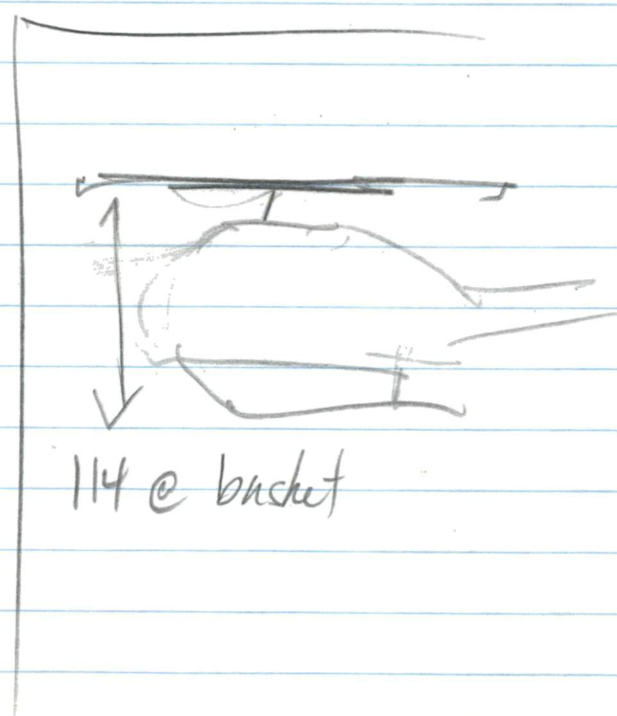
Aft small door doesn't open.



shift beams down.

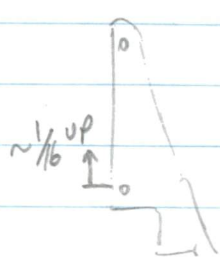
- Sliding door fits.
- handle does not

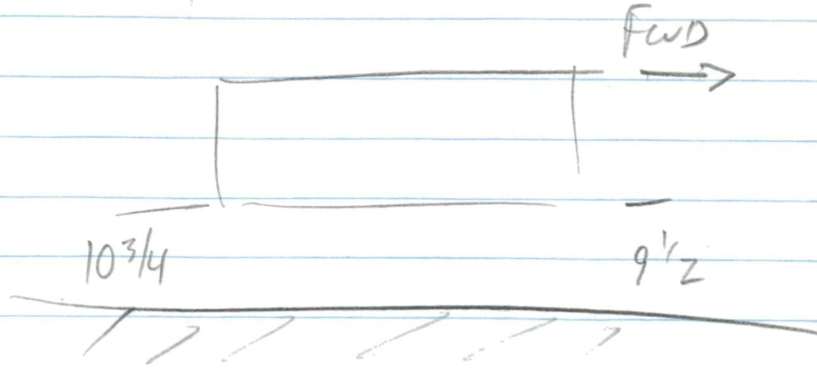




Aft beam → 31.5" spacing good.

Aft fitting



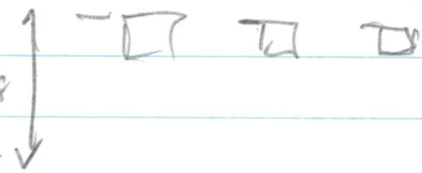


Basket on Rt side no good for regular access

Bike rack out board 1" min
↳ door handle doesn't clear

Pedals clear

Swap down tubes



fwd 20 1/8
aft 21 1/8

Some motion between w/ bike-rack

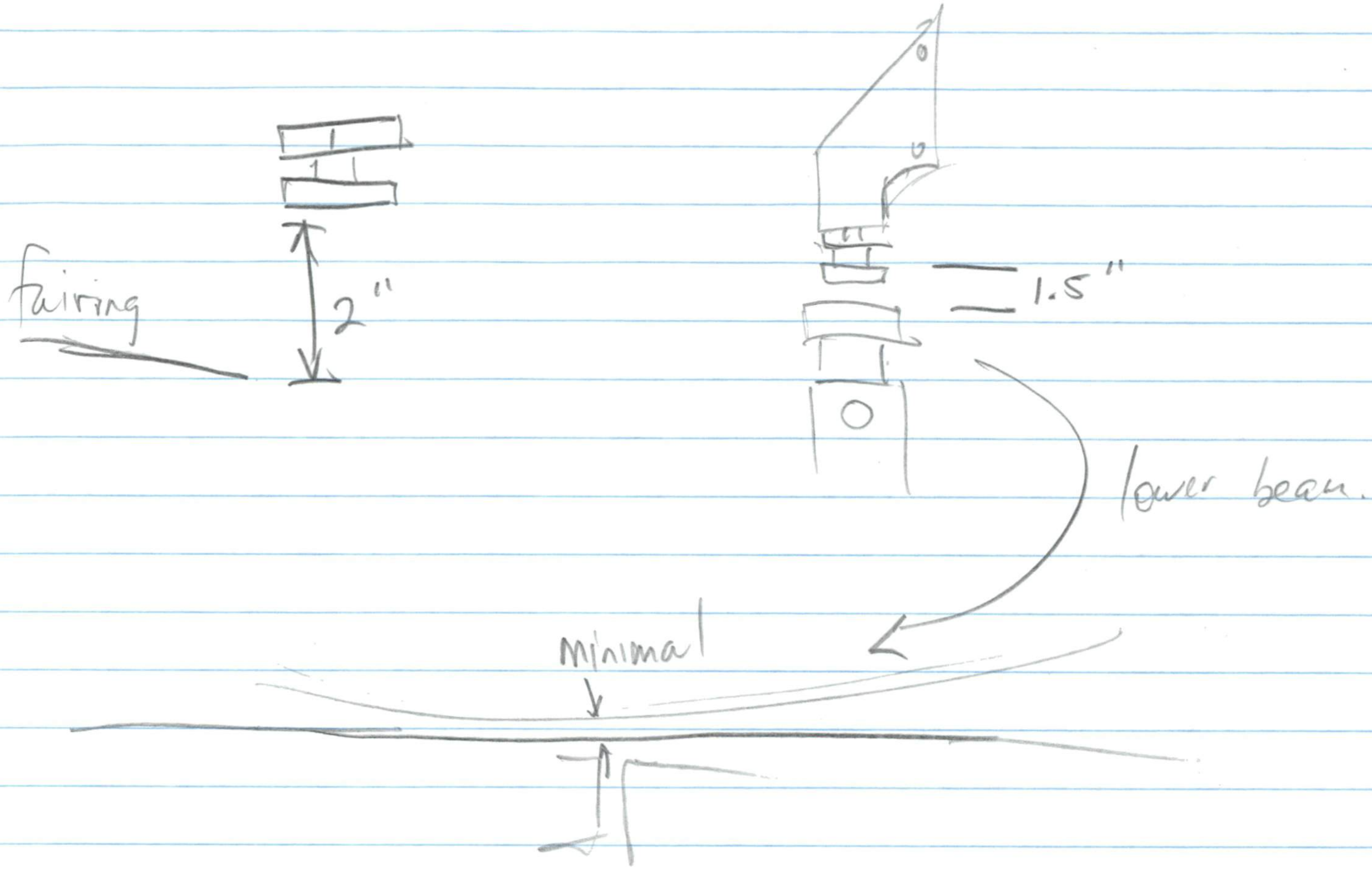
Swap beams might fix

Cargo swing fits
↳ Pulling swing all the way fwd
- Cables do not touch beam
- aft completely clear

Bike rack → Shift position back to end of bar.
to clear check.

→ middle bike good now, door clears w/
wide bars

Pilot access good w/ bike rack.


fairing
2"
1.5"
lower beam.
minimal

ALUMINIUM ALLOY SEMI-FINISHED PRODUCTS
SHEET

THICKNESS	WEIGHT kg/cm2	DIMENSIONS				
		WIDTH			LENGTH	
		800	1000	1250	2000	2500
0,3		X				X
0,4	1,12	X		X	X	X
0,5	1,40	X		X		X
0,6	1,68			X		X
0,7	1,96			X		X
0,8	2,24			X		X
0,9	2,52			X		X
1	2,80			X		X
1,2	3,36			X		X
1,4	3,92			X		X
1,6	4,48			X		X
1,8	5,04			X		X
2	5,60			X		X
2,5	7,00			X		X
3	8,40		X		X	
3,2	8,96			X		X
3,5	9,80			X		X
4	11,20			X		X
5	14,00					
6	16,80					
8	22,40					
10	28,00			X		X
12	33,60		X		X	
16	44,80		X	X	X	X
20	56,00		X		X	
25	70,00		X		X	
30	84,00		X		X	
32	89,60		X		X	
35	98,00		X		X	
40	112,00		X		X	
45	126,00		X		X	
50	140,00		X		X	
55	154,00		X		X	
60	168,00		X		X	
63	176,40					
65	182,00		X		X	
70	196,00					
90	252,00					
100	280,00					
120	336,00					
140	392,00					

DEPENDING ON STOCKS, CERTAIN SHEETS MAY BE DELIVERED IN ALTERNATE DIMENSIONS

PROCUREMENT

Every standard part shall be identified by its reference only

Example: AU4G1 T3 EPO=0,6 TOLE 1250x2500

- AU4G1 — Material
- T3 — Condition
- EPO=0,6 — Thickness in mm
- TOLE — Designation
- 1250x2500 — Width x length in mm

Manufacturer NATO code: F0210

CERTIFICATION PLAN

CP1002

AIRBUS HELICOPTERS AS350 & AS355 ALL MODELS
AIRBUS HELICOPTERS EC130 B4

QUICK RELEASE BICYCLE RACK INSTALLATION

Reviewed by Jason
15/07/2015

Prepared by: Jeff Clarke, P.Tech.(Eng.)

Revision 1, 29 June 2015

Aero Design Ltd.

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www.aerodesign.ca

TABLE OF CONTENTS

1.0 INTRODUCTION

This certification plan details the means and methods of compliance for the Airworthiness Requirements shown on the Compliance Program Checklist (Appendix A and B).

2.0 DEFINITIONS

The following abbreviations are used in this document:

FMS – Flight Manual Supplement

ICA – Instructions for Continued Airworthiness

3.0 PERSONNEL

Applicant: Aero Design Ltd. – Jeff Clarke, P.Tech.(Eng.)

Delegate: DAR304 James Tinson, P.Eng.

Transport Canada: Michael Chan, Pacific Region

4.0 PROJECT DESCRIPTION

There has been increased interest from helicopter operators to support heli-biking excursions as part of their offerings. Currently, the operation requires the loading of many bikes into a cargo net and slinging the bikes up the mountain, unloading the bikes, then returning to pick up the riders to carry them up the mountain. This operation, while workable, is not ideal for a number of reasons: at a minimum 2 flights are required for each excursion driving time and costs up; it requires the attachment/removal of the cargo net and long-line between each trip; the bikes can be quite expensive and loading in a cargo net allows the bikes to rub and scratch against one another causing damage.

The Quick Release Bicycle Rack is installed on the helicopter using the Mounting Provisions supplied for use with the Quick Release Cargo Basket. The rack can support up to 3 bikes and can be installed on both sides of the helicopter for a total of 6. The maximum load per bike is 50 lbs (23 kg). The rack itself consists of 3 parallel tracks made of an aluminum extrusion used for cabin steps, with stainless steel tubing frames to secure the bicycles. The tube frames can accommodate tires from 26" – 29" (660 – 737 mm) diameter and up to 4" (100 mm) wide, standard sizes for mountain and downhill biking. The aft tube frame is fixed in position; the forward frame slides to allow for a tight fit on the range of tire and frame sizes. The forward frame locks to the track with a cam action that puts pressure aft and down on the tire to secure the bicycle tightly into the frame. The cam action will also secure the forward frame from moving when there is no bike on the rack.

The AS350 and EC130 configurations use many common components. The primary difference is the location of the mounting provisions. On the EC130 the inboard rail extends forward to the mounting provision, which provides for a cabin access step with the bike rack installed.

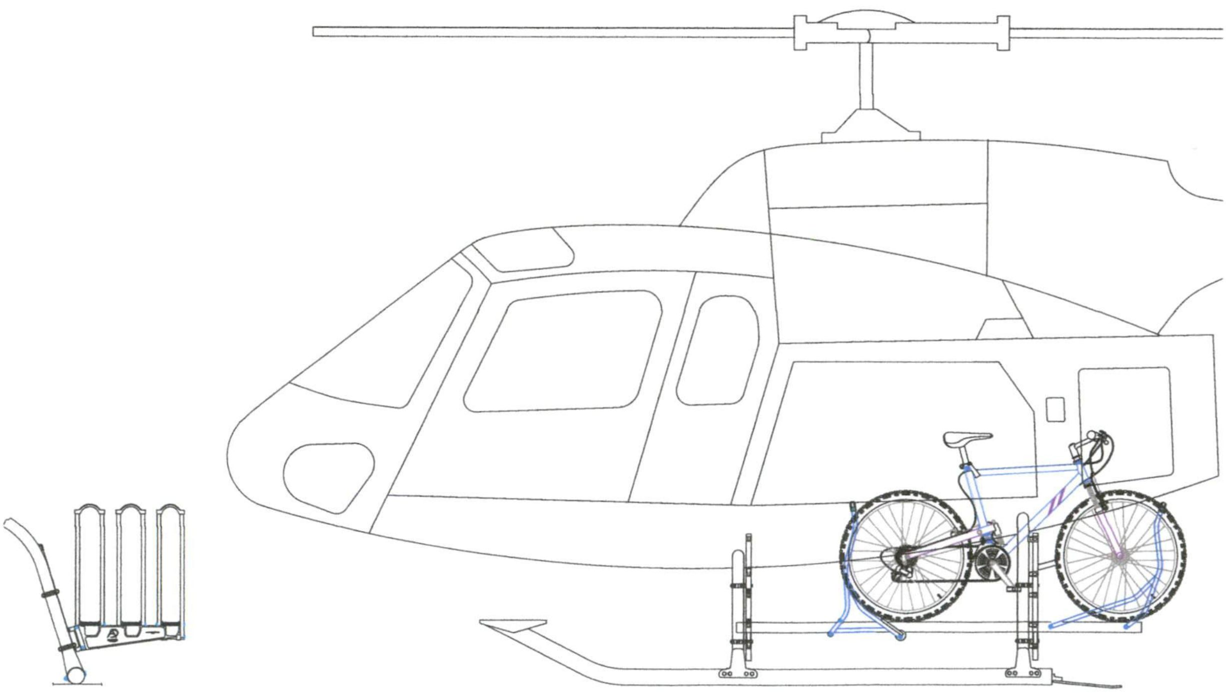

Figure 4.0.1 – AS350 Quick Release Bicycle Rack Installation

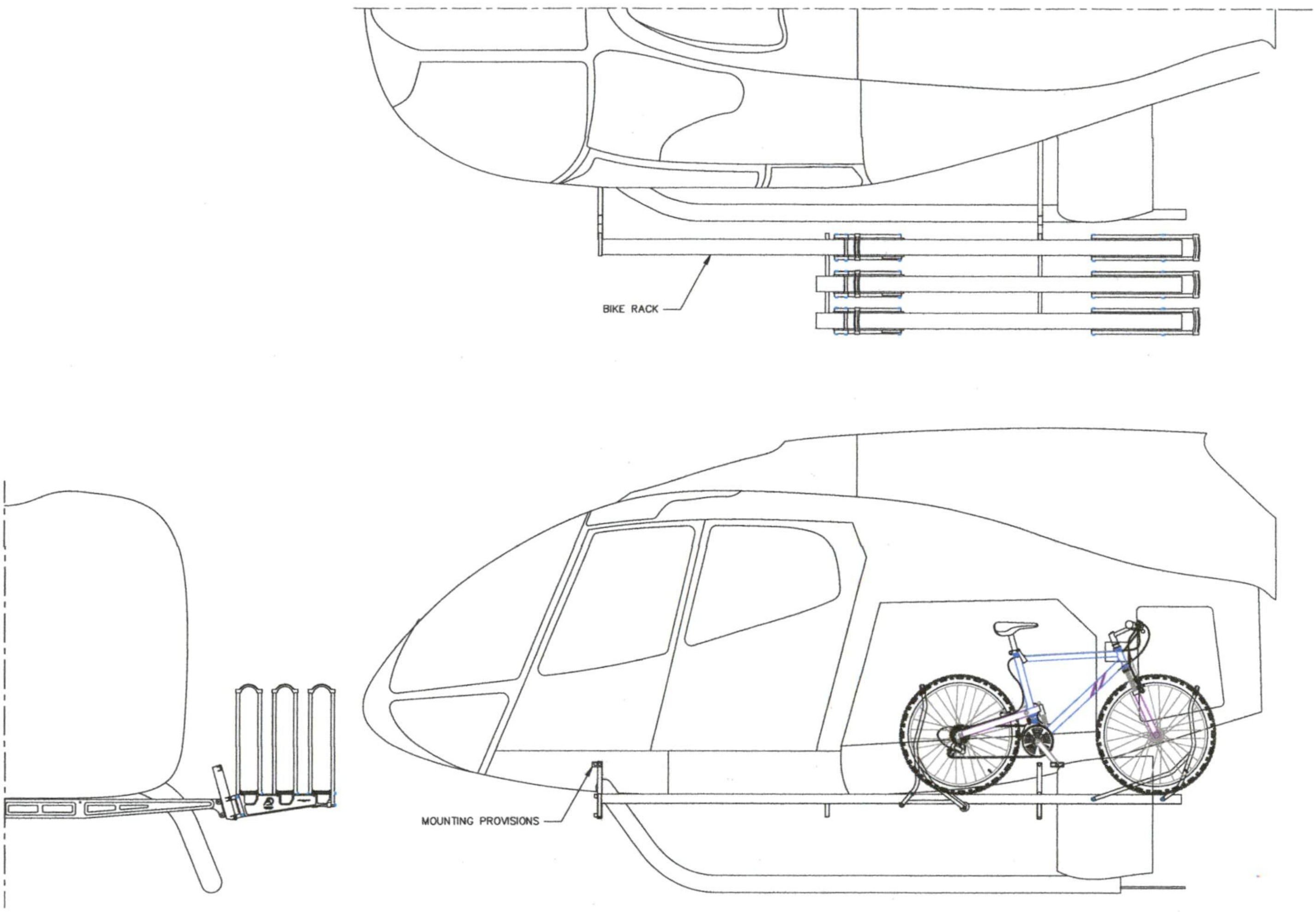

Figure 4.0.2 – EC130 Quick Release Bicycle Rack Installation

5.0 BASIS OF CERTIFICATION

5.1 Type Certificates

Model: Airbus Helicopters AS350 D, B, BA, B1, B2, B3; EC130 B4

TCDS:

- TCCA: H-83 Issue 22
- FAA: H9EU Revision 23
- EASA: R.008 Issue 8

Note: This installation may not be applicable to the EC130 T2 due to differences in the aft fuel cell support structure related to the crashworthy fuel cell.

Model: Airbus Helicopters AS355 E, F, F1, F2, N, NP

TCDS:

- TCCA: H-87 Issue 9
- FAA: H11EU Revision 10
- EASA: R.146 Issue 2

5.2 TCCA Basis of Certification

5.2.1 AS350 – TCDS H-83, Issue 22

The certification basis is as follows (AS350B3, most recent):

FAR 27 effective February 1, 1965 including Amdts 27-1 through 27-10.

DGAC Special Conditions notified by DGAC letter 971726 dated April 3, 1997, plus TCCA Additional Airworthiness Requirement as published in Airworthiness Manual Chapter 527 (Normal Category Rotorcraft) First Edition, July 1986:

a) 527.1301-1 Rotorcraft Operations After Ground Cold Soak
b) 527.1557(c)(3) Miscellaneous Markings and Placards
c) 527.1581 Rotorcraft Flight Manual
d) 527.1583(h) Operating Limitations, Ambient Temperature

5.2.2 AS355 – TCDS H-87, Issue 9

The certification basis is as follows (AS355NP, most recent):

1) FAR 27 Amendment 20, dated March 26,1984, (such as modified by CTC 27) plus the following paragraphs of Amendment 21, dated December 6,1984:

27.21, 27.45, 27.71, 27.79, 27.143, 27.151, 27.161, 27.173, 27.175, 27.177, 27.672, 27.673, 27.729, 27.735, 27.779, 27.807, 27.1329, 27.1413, 27.1519, 27.1525, 27.1555, 27.1585, 27.1587; Plus FAR 27 amendment 23, paragraph 27.923.

2) In support of Category A operations, the following FAR paragraphs (CRI A-3):

Amdt 0: 29.953(a); 29.1187(e); 29.1201
Amdt 3: 29.1191(a)(l)
Amdt 13: 29.1197

Amdt 14: 29.1309(b) (2)(i) and (d)
Amdt 17: 29.1195(a) and (d)
Amdt 24: 29.45(a) and (b)(2); 29.1331(b)
Amdt 26: 29.901(c); 29.908(a); 29.1027(a); 29.1045(a)(l) (b) (c) (d) and (f); 29.1047(a); 29.1181(a); 29.1189(c); 29.1193(e)
Amdt 30: 29.861(a)
Amdt 36: 29.903(b)(c) and (e)
Amdt 39: 29.49(a); 29.51; 29.53; 29.55; 29.60; 29.61; 29.64; 29.65(a); 29.75; 29.79; 29.87(a)
Amdt 40: 29.917(c)(1) - Rotor drive system: Design; 29.1305(b)
Amdt 44: 29.59; 29.62; 29.67(a); 29.77; 29.81; 29.85; 29.1323(c)(1); 29.1587(a)

3) Special Conditions:

a) Limit pilot forces, engine air intake protection against 2 lb bird and hail ingestion and the engine governing system as documented in DGAC letter No. 54408 dated October 21, 1988.

b) Protection against the effects of High Intensity Radiated Fields (CRI F-1).

4) Equivalent Safety Findings: Powerplant instrument markings (CRI F-4).

5) Environmental Standards:

a) Noise: CS36 (Provisions of Chapter 8 of ICAO Annex 16, Volume I, Part 11);

b) Fuel Venting: CS-34 (Provisions of Chapter 11 of ICAO Annex 16, Volume 11, Part 11)

6) Additional Airworthiness Requirements (AARs) Canadian Airworthiness Manual, Chapter 527 (Normal Category Rotorcraft):

a) 527.1093(b)(l)(ii) and (iii) Induction System Icing Protection

b) 527.1301-1 Rotorcraft Operations After Ground Cold Soak

c) 527.1557(c) (3) Miscellaneous Markings and Placards

d) 527.1583(h) Ambient Temperature Limitation

5.2.3 EC130 B4 – TCDS H-83, Issue 22

The following Certification Basis has been accepted as equivalent to the Airworthiness Manual Chapter 527 at Change 3 dated January 3, 1994:

a) JAR 27 First Issue dated September 6, 1993 with orange paper amendment 27/98/1 effective February 16, 1998.

b) JAA Special Condition on High Intensity Radiated Field.

c) Exemption for Rear Bench Seat regarding JAR 27-562 and JAR 27-785(a),(b),(j) and for Fuel Systems regarding JAR 27.952(a),(c),(d),(f),(g).

d) Equivalent Safety Findings on Main Gearbox Oil Filter By Pass and Powerplant Instrument Markings.

e) Provisions of ICAO Annex 16, Volume I, Third Edition, Amendment 5, Chapter 8.

f) Fuel Discharge as per ICAO Second Edition dated July 1993 Annex 16, Volume 2, 2nd Part.

g) In addition the following Transport Canada Additional Airworthiness Requirements as published in the Canadian Airworthiness Manual, Chapter 527, Change 3 dated January 3, 1994:

i) 527.1093 (b)(I) Engine Operation in Snow
ii) 527.1301-1 Rotorcraft Operations After Ground Cold Soak
iii) 527.1557(c)(3) Miscellaneous Markings and Placards
iv) 527.1581(e),(f) Rotorcraft Flight Manual
v) 527.1583(h) Operating Limitations, Ambient Temperature

AWM 516, *Aircraft Emissions*: Subchapter A for Aircraft Noise (this refers to International Civil Aviation Organization (ICAO) Annex 16, Volume I) and Subchapter B for Prevention of Vented Fuel (this refers to ICAO Annex 16, Volume II, Part 11).

Arriel2B1 engine -Third Edition/Arndt 5, Chapter 8

5.3 Equivalency of Canadian to FAA Basis of Certification

This section addresses the FAA basis of certification for which this approval may be familiarized following issue of the Canadian approval.

5.3.1 AS350 – TCDS H9EU, Revision 23

The Canadian basis of certification defined on TCDS H-83 is the same as the FAA basis of certification defined on TCDS H9EU.

5.3.2 AS355 – TCDS H11EU, Revision 10

The Canadian basis of certification defined on TCDS H-87 is the same as the FAA basis of certification defined on TCDS H11EU.

5.3.3 EC130 B4 – TCDS H9EU, Revision 23

14 CFR 21.29 and part 27 Amendment 27-1 through Amendment 27-32, except 14 CFR 27.952 is not adopted.

14 CFR 36 Appendix H through Amendment 20.

Special Condition 27-009-SC for HIRF.

Equivalent Level of Safety Findings

- 14 CFR 27.1549(b) Powerplant Instrument Markings

- 14 CFR 27.1027(b)(2) Main Gearbox Oil Filter Bypass

The Canadian basis of certification defined on TCDS H-83 is equivalent to the FAA basis of certification defined on TCDS H9EU.

5.4 Equivalency of Canadian to EASA Basis of Certification

This section addresses the EASA basis of certification for which this approval may be familiarized following issue of the Canadian approval.

5.4.1 AS350 – TCDS R.008, Issue 8

The Canadian basis of certification defined on TCDS H-83 is the same as the EASA basis of certification defined on TCDS R.008.

5.4.2 AS355 – TCDS R.146, Issue 2

The Canadian basis of certification defined on TCDS H-87 is the same as the EASA basis of certification defined on TCDS R.146.

5.4.3 EC130 B4 – TCDS R.008, Issue 8

JAR 27 first issue dated September 6, 1993, and orange paper amendment 27/98/1 effective February 16, 1998.

Exemption for Rear Bench Seat regarding JAR 27-562 and JAR 27-785(a),(b),(j) and for Fuel Systems regarding JAR 27952(a),(c),(d),(f),(g).

Equivalent Safety Findings on Main Gearbox Oil Filter By Pass and Powerplant Instrument Markings.

The Canadian basis of certification defined on TCDS H-83 is equivalent to the EASA basis of certification defined on TCDS R.008, as stated on TCDS H-83.

5.5 This Modification

The basis of certification for this modification has been considered in accordance with CAR 521.158 - Standards of Airworthiness, SI 521-004 and SI 521-005, and AC 500-16. The Changed Product Rule Decision Record, CPR-DR1002, Rev. 0 (Appendix C), documents the following findings with regards to this modification:

- this modification is not substantial
- the latest standards will not be used
- this change is not significant
- the basis of certification for this modification remains the same as the original basis of certification for the aircraft as defined in the TCDS.

The FAA basis of certification is more clearly written and has better control over previous revisions to the FARs, therefore it is proposed to use the FAA basis of certification for this project.

The Canadian Additional Airworthiness Requirements, as applicable, are addressed as shown below:

a) 527.1093 (b)(I) Engine Operation in Snow
b) 527.1301-1 Rotorcraft Operations After Ground Cold Soak

c) 527.1557(c)(3) Miscellaneous Markings and Placards
d) 527.1581(f) Rotorcraft Flight Manual
e) 527.1583(h) Operating Limitations, Ambient Temperature
f) 527.1581(f) Rotorcraft Flight Manual

This installation introduces no changes from Type Approved configuration for the above paragraphs.

g) 527.1581(e) Rotorcraft Flight Manual

This installation includes metric units as required by 527.1581(e).

(Note this paragraph has been removed from the standards at Change 527-4.)

Please indicate agreement that the basis of certification for this project shall be to the FARs as defined on the FAA TCDS H9EU / H11EU as applicable by signing below, or providing said agreement via email.

For Transport Canada Civil Aviation Date

6.0 APPLICABILITY OF AIRWORTHINESS DIRECTIVES

Airworthiness Directives applicable to the Airbus Helicopters AS350 and AS355 were reviewed on 29 April 2015, and none were found to be affected by this project.

Airworthiness Directives applicable to the Airbus Helicopters EC130 B4 were reviewed on 29 April 2015, and none were found to be affected by this project.

7.0 CERTIFICATION PLAN

The certification plan and compliance checklists (Appendix A and B) use the FAR paragraphs as they either form the basis of certification or have been determined to be equivalent to the Canadian basis of certification for each model, refer to section 5.5.

FAR 27 Subpart B - Flight

7.1 27.29 – Empty Weight and Corresponding C of G

7.1.1 Means of Compliance

a) Review, calculate and inspect

7.1.2 Method of Compliance

a) Weight and balance information required to compute the aircraft empty weight and corresponding C of G with the bicycle rack installed is provided on the installation drawing as well as in the Instructions for Continued Airworthiness.

7.1.3 Compliance Documents, Data and Testing

a) Installation drawings: 100201, 100202
b) Instructions for Continued Airworthiness ICA1002.91 Revision 0

7.1.4 Level of Delegation

Finding of compliance to FAR 27.29 delegated.

7.1.5 Level of Involvement / Service

None

7.2 27.45, .51, .65, .71, .73, .75, .141, .143, .171, .173, .175, .177, .241, .251 – Flight Requirements, and 27.547 – Main Rotor Structure (Mast Bending)

7.2.1 Means of Compliance

a) Test

7.2.2 Method of Compliance

a) Company flight test to ensure installation does not produce excessive vibration and determine the handling qualities of the aircraft are adequate prior to TCCA flight test, in accordance with Flight test plan and report FTP1002.03 (AS350/AS355) and FTP1002.07 (EC130 B4).
b) Vibrations on test aircraft configurations to be compared to unmodified aircraft using vibration analysis equipment. Flight test plan and report FTP1002.03 (AS350/AS355) and FTP1002.07 (EC130 B4) as applicable will detail the extent of the vibration analysis pass/fail criteria and a baseline spectrum will be included for comparison.
c) Comprehensive TCCA flight tests to determine flight characteristics and limitations.

7.2.3 Compliance Documents, Data and Testing

a) Flight test plan and report FTP1002.03 (AS350/AS355), FTP1002.07 (EC130 B4).
b) Flight test report prepared by TCCA flight test pilot

7.2.4 Level of Delegation

Not delegated

7.2.5 Level of Involvement / Service

a) TCCA to accept flight test plan FTP1002.03 and FTP1002.07.
b) TCCA Flight test
c) Finding of compliance for flight requirements paragraphs

Subpart C – Strength Requirements

7.3 27.301, .303, .305, .307, .337, .625 – Strength Requirements

7.3.1 Means of Compliance

a) Analysis
b) Test

7.3.2 Method of Compliance

a) Analysis to determine applied loads
b) Analysis and load tests to show proof of compliance

7.3.3 Compliance Documents, Data and Testing

a) Engineering Reports: ER1002.01, ER1002.05
b) Load Test Reports: TR1002.02, TR1002.06

7.3.4 Level of Delegation

a) Finding of compliance to FAR 27.301, .303, .305, .307, .337, .561 delegated.

7.3.5 Level of Involvement / Service

a) TCCA to accept air drag loads in ER1002.01, ER1002.05
b) TCCA to accept load test plans TR1002.02, TR1002.06

Subpart D – Design and Construction

7.4 27.601, .603, .605, .609, .611 – Design Requirements

7.4.1 Means of Compliance

a) Review and inspect
b) Functional tests

7.4.2 Method of Compliance

a) Specifications on fabrication drawings
b) 27.601(a): This design does not include design features or details that experience has shown to be hazardous or unreliable.
c) 27.601(b): Suitability of the movable section for locking the bicycles in place will be demonstrated by test.

7.4.3 Compliance Documents, Data and Testing

a) Fabrication drawings
b) Functional test performed in TR1002.06 (EC130 B4);
c) Reference to test performed TR1002.06 in TR1002.02 (AS350/AS355)

7.4.4 Level of Delegation

a) Finding of compliance to FAR 27.601, .603, .605, .609, .611 delegated.

7.4.5 Level of Involvement / Service

None.

7.5 27.613 – Material Requirements

7.5.1 Means of Compliance

a) Analysis

7.5.2 Method of Compliance

a) Strength properties in accordance with material specifications and AR-MMPDS-01 as applicable

7.5.3 Compliance Documents, Data and Testing

a) Fabrication drawings

7.5.4 Level of Delegation

a) Finding of compliance to FAR 27.613 delegated.

7.5.5 Level of Involvement / Service

None.

7.6 27.783, .807 – Doors / Emergency Exits

7.6.1 Means of Compliance

a) Review and inspect.

7.6.2 Method of Compliance

a) Statement in ER1002.01 (AS350/AS355) and ER1002.05 (EC130 B4) regarding access to cabin doors.

7.6.3 Compliance Documents, Data and Testing

a) Engineering Reports ER1002.01 (AS350/AS355) and ER1002.05 (EC130 B4)

7.6.4 Level of Delegation

a) Finding of compliance to FAR 27.807 delegated.

7.6.5 Level of Involvement / Service

a) Finding of compliance to FAR 27.783.

7.7 27.787 – Cargo Compartments

7.7.1 Means of Compliance

a) Review and inspect.
b) Analysis

7.7.2 Method of Compliance

a) Analysis in ER1002.01 (AS350/AS355) and ER1002.05 (EC130 B4) uses load factors specified in FAR 27.301 thru 27.337
b) Statement in ER1002.01 and ER1002.05 regarding locking mechanism
c) Statement in ER1002.01 and ER1002.05 regarding access to escape facilities

7.7.3 Compliance Documents, Data and Testing

a) Engineering Report ER1002.01 (AS350/AS355)
b) Engineering Report ER1002.05 (EC130 B4)

7.7.4 Level of Delegation

a) Finding of compliance to FAR 27.787 delegated.

7.7.5 Level of Involvement / Service

None.

7.8 27.865 – External Loads

The bicycle rack installation is clearly a Class A rotorcraft external load (non-jettisonable, not extending below the landing gear). FAR 27.865 is not used for the bicycle rack installation because the operating rules for external loads in the FAA system, Part 133, specifically preclude the carriage of passengers during external loads operations. TCCA permits the carrying of passengers with external loads in CAR 703.25 – Air Taxi Operations, External Loads, when the external load installation is approved by a supplemental type certificate.

To prevent classification as a Class A external load in the FAA system and the requirement to operate under Part 133, the bicycle rack is considered a cargo compartment and uses the loads specified in FAR 27.787, which are higher than the 2.5g maximum vertical load factor specified in 27.865.

Subpart G – Operating Limitiations and Information

7.9 27.1505, .1525, .1581, .1583(c), .1585, .1587

7.9.1 Means of Compliance

a) Test
b) Flight Manual Supplement

7.9.2 Method of Compliance

a) TCCA flight test to determine limitations
b) Flight Manual Supplement provided which includes operating limitations, operating procedures, performance information and loading information.

7.9.3 Compliance Documents, Data and Testing

a) Flight Manual Supplement FMS1002.91 (AS350/AS355)
b) Flight Manual Supplement FMS1002.92 (EC130 B4)

7.9.4 Level of Delegation

None

7.9.5 Level of Involvement / Service

a) TCCA to approve FMS1002.91, FMS1002.92
b) Finding of compliance to FAR 27.1505, .1525, .1581, .1583(c), .1585, .1587

7.10 27.1557 – Markings and Placards

7.10.1 Means of Compliance

a) Placard provided

7.10.2 Method of Compliance

a) Placard specifies loading limitations

7.10.3 Compliance Documents, Data and Testing

a) Fabrication drawings

7.10.4 Level of Delegation

a) Finding of compliance to FAR 27.1557 delegated.

7.10.5 Level of Involvement / Service

None.

7.11 27.1529 - ICA

7.11.1 Means of Compliance

a) Instructions for Continued Airworthiness provided

7.11.2 Method of Compliance

a) Instructions for Continued Airworthiness are prepared in accordance with FAR 27 Appendix A

7.11.3 Compliance Documents, Data and Testing

c) Instructions for Continued Airworthiness ICA1002.90

7.11.4 Level of Delegation

None

7.11.5 Level of Involvement / Service

a) TCCA to accept ICA1002.90

b) Finding of compliance to FAR 27.1529

7.12 Schedule

The following schedule is proposed and will be updated as items are changed or completed.

Proposed target completion date: ~~01 June 2015~~

7.12.1 Airbus Helicopters AS350 / AS355

Item	Deliverable	TCCA Level of Involvement / Service	Submission Date (proposed)	Approval / Acceptance (initial)	Date
Flight test plan (Section 7.3.5)	FTP1002.03	Accept test plan			
Flight test report (Section 7.3.5)	FTP1002.03	Accept results			
TCCA Flight test (Section 7.3.5)	Report	Flight test by TCCA pilot	N/A		
Engineering Report – Air Drag Loads (Section 7.4.5)	ER1002.01	Accept air drag loads			
Load test report (Section 7.4.5)	TR1002.02	Accept test plan			
Engineering Report (Section 7.7.5)	ER1002.01	Finding of compliance to CAR 27.783			
Flight Manual Supplement (Section 7.9.5)	FMS1002.91	Review and approval			
ICA (Section 7.11.5) (MSI 53)	ICA1002.90	Review and acceptance			
Findings of Compliance (Section 7.3.5, 7.7.5, 7.9.5, 7.11.5)	CP1002 (checklist)	Finding of compliance to indicated paragraphs on compliance program checklist (Appendix A)			

7.12.2 Airbus Helicopters EC130 B4

Item	Deliverable	TCCA Level of Involvement / Service	Submission Date (proposed)	Approval / Acceptance (initial)	Date
Flight test plan (Section 7.3.5)	FTP1002.07	Accept test plan			
Flight test report (Section 7.3.5)	FTP1002.07	Accept results			
TCCA Flight test (Section 7.3.5)	Report	Flight test by TCCA pilot	N/A		
Engineering Report – Air Drag Loads (Section 7.4.5)	ER1002.05	Accept air drag loads			
Load test report (Section 7.4.5)	TR1002.06	Accept test plan			
Engineering Report (Section 7.7.5)	ER1002.05	Finding of compliance to CAR 27.783			
Flight Manual Supplement (Section 7.9.5)	FMS1002.92	Review and approval			
ICA (Section 7.11.5) (MSI 53)	ICA1002.90	Review and acceptance			
Findings of Compliance (Section 7.3.5, 7.7.5, 7.9.5, 7.11.5)	CP1002 (checklist)	Finding of compliance to indicated paragraphs on compliance program checklist (Appendix B)			

APPENDIX A

COMPLIANCE PROGRAM CHECKLIST –

AIRBUS HELICOPTERSAS350 & AS355

APPLICANT: Aero Design Ltd.
9888 A Malaspina Road
Powell River, BC, Canada
V8A 0G3

CORRESPONDANCE TO:
(If other than applicant)

DATE: 29 April 2015
REVISION No. 1, 29 June 2015

MAKE: Airbus Helicopters
MODEL: AS350 D, B, BA, B1, B2, B3; AS355 E, F, F1, F2, N, NP

REGISTRATION: All Eligible
SERIAL No.: All Eligible

NATURE OF WORK: Quick Release Bike Rack Installation
TYPE CERTIFICATE DATA SHEET: H-83, H-87
MODEL CERTIFICATION BASIS: FAR 27, Amendment 20 plus sections of Amendment 21 (AS355 NP, most recent of AS350/AS355 models)
MODIFICATION CERTIFICATION BASIS: Same as original basis of certification

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
Subpart B - Flight						
27.29	20	Empty Weight and Corresponding C of G	Data specified on inst'n drawing		X	
27.45	21	Performance - General	Flight Test	X		Preliminary flight tests performed by Aero Design in accordance with Flight Test Plan FTP1002.03 Certification flight tests performed by TCCA test pilot
27.51	20	Takeoff data: General	Flight Test	X		
27.65	20	Climb: All Engines Operating	Flight Test	X		
27.71	21	Autorotation Performance	Flight Test	X		
27.73	20	Performance at Min. Operating Speed	Flight Test	X		
27.75	20	Landing	Flight Test	X		
27.141	20	Flight Characteristics – General	Flight Test	X		
27.143	21	Controllability and Maneuverability	Flight Test	X		
27.171	20	Stability – General	Flight Test	X		
27.173	21	Static Longitudinal Stability	Flight Test	X		
27.175	21	Demonstration of Longitudinal Stability	Flight Test	X		
27.177	21	Static Directional Stability	Flight Test	X		
27.241	20	Ground Resonance	Flight Test	X		
27.251	20	Vibration	Flight Test	X		

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
Subpart C – Strength Requirements						
27.301	20	Loads – Air Drag Loads	Analysis in ER1002.01	X		
27.301	20	Loads – Inertia Loads	Compliance with 27.337 and 27.561		X	
27.303	20	Factor of Safety	Analysis in ER1002.01		X	
27.305	20	Strength and Deformation	Analysis in ER1002.01 and Test iaw Test Plan TR1002.02		X	
27.307	20	Proof of Structure			X	
27.337(a)	20	Limit Maneuvering Load Factor			X	Critical load factor in vertical direction.
27.547	20	Main Rotor Structure	Flight Test	X		See comments for flight test above
27.561(b) (3)	20	Occupant Protection	N/A			Not an item of mass inside the cabin
27.561(c)	20	Items of Mass	N/A Statement in report ER1002.01			Bike racks are not located above/behind the cabin. Forward deflection or failure of bike rack poses no threat to occupants of cabin. 27.337 Maneuvering Loads are critical vertical loads.
Subpart D – Design and Construction						
27.601	20	Design	Review and Inspect; functional test in TR1002.02		X	
27.603	20	Materials	Drawings		X	Materials as specified in AR-MMPDS-01
27.605	20	Fabrication Methods	Drawings		X	Design is conventional.
27.609	20	Protection of Structure	Drawings		X	
27.611	20	Inspection Provisions	Drawings		X	Design is easy to inspect.
27.613	20	Material Strength Properties and Design Values	Values used as per AR-MMPDS-01		X	
27.625	20	Fitting Factor	Analysis		X	
27.783	20	Doors	Statement in ER1002.01	X		Bike rack is located aft of cabin doors.
27.787(a)	20	Cargo and Baggage Compartments	Compliance with 23.301 through 307		X	
27.787(b)	20	Cargo and Baggage Compartments	Statement in ER1002.01		X	Bike rack has positive locks to secure bikes.

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
27.787(c) (1)	20	Cargo and Baggage Compartments	Statement in ER1002.01		X	Cargo is external to helicopter, position will not restrict escape facilities
27.807	21	Emergency Exits	Statement in ER1002.01		X	Installation does not block doors form opening
27.865	20	External Loads	N/A – Statement in CP1009			
27.1387	20	Position Light System Dihedral Angles	N/A – statement in ER1002.01			No change from Type Approval.
27.1401	20	Anticollision Light System	N/A – statement in ER1002.01			No change from Type Approval.
Subpart G – Operating Limitations and Information						
27.1505	20	Never Exceed Speed	Flight Test, Flight Manual Supplement FMS1002.91	X		V_{NE} limits to be determined by flight test
27.1525	21	Kinds of Operation	FMS1002.91	X		Limited to VFR only.
27.1529	20	Instructions for Continued Airworthiness	ICA Provided, ICA1002.90	X		
27.1557(a)	20	Miscellaneous Markings and Placards – Baggage Compartments	Placard on rack		X	
27.1581	20	Rotorcraft Flight Manual – General	FMS1002.91	X		
27.1583(c)	20	Operating Limitations – Weight and Loading Information	FMS1002.91	X		
27.1585	21	Operating Procedures	FMS1002.91	X		
27.1587	21	Performance Information	FMS1002.91	X		
27.1589	20	Loading Information	FMS1002.91 & Placard	X		Placard installed on bike rack

APPENDIX B

COMPLIANCE PROGRAM CHECKLIST –

AIRBUS HELICOPTERS EC130 B4

APPLICANT:	Aero Design Ltd. 9888 A Malaspina Road Powell River, BC, Canada V8A 0G3	DATE:	29 April 2015
		REVISION No.	1, 29 June 2015
		MAKE:	Airbus Helicopters
CORRESPONDANCE TO: (If other than applicant)		MODEL:	EC130 B4
		REGISTRATION:	All Eligible
		SERIAL No.:	All Eligible

NATURE OF WORK: Quick Release Bike Rack Installation
TYPE CERTIFICATE DATA SHEET: H-83
MODEL CERTIFICATION BASIS: AWM 527 at Change 527-3, equivalent to FAR 27 at amendment 32
MODIFICATION CERTIFICATION BASIS: Same as original basis of certification

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
Subpart B - Flight						
27.29	32	Empty Weight and Corresponding C of G	Data specified on inst'n drawing		X	
27.45	32	Performance - General	Flight Test	X		
27.51	32	Takeoff data: General	Flight Test	X		
27.65	32	Climb: All Engines Operating	Flight Test	X		
27.71	32	Autorotation Performance	Flight Test	X		
27.75	32	Landing	Flight Test	X		
27.73	32	Performance at Min. Operating Speed	Flight Test			Preliminary flight tests performed by Aero Design in accordance with Flight Test Plan FTP1002.07 Certification flight tests performed by TCCA test pilot
27.141	32	Flight Characteristics – General	Flight Test	X		
27.143	32	Controllability and Maneuverability	Flight Test	X		
27.171	32	Stability – General	Flight Test	X		
27.173	32	Static Longitudinal Stability	Flight Test	X		
27.175	32	Demonstration of Longitudinal Stability	Flight Test	X		
27.177	32	Static Directional Stability	Flight Test	X		
27.241	32	Ground Resonance	Flight Test	X		
27.251	32	Vibration	Flight Test	X		

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
Subpart C – Strength Requirements						
27.301	32	Loads – Air Drag Loads	Analysis in ER1002.05	X		
27.301	32	Loads – Inertia Loads	Compliance with 27.337 and 27.561		X	
27.303	32	Factor of Safety	Analysis in ER1002.05		X	
27.305	32	Strength and Deformation	Analysis in ER1002.05 and Test iaw Test Plan TR1002.06		X	
27.307	32	Proof of Structure			X	
27.337(a)	32	Limit Maneuvering Load Factor			X	Critical load factor in vertical direction.
27.547	32	Main Rotor Structure	Flight Test	X		See comments for flight test above
27.561(b) (3)	32	Occupant Protection	N/A			Not an item of mass inside the cabin
27.561(c)	32	Items of Mass	N/A Statement in report ER1002.05			Bike rack are not located above/behind the cabin. Forward deflection or failure of bike rack poses no threat to occupants of cabin. 27.337 Maneuvering Loads are critical vertical loads.
Subpart D – Design and Construction						
27.601	32	Design	Review and Inspect; functional test in TR1002.06		X	
27.603	32	Materials	Drawings		X	Materials as specified in AR-MMPDS-01
27.605	32	Fabrication Methods	Drawings		X	Design is conventional.
27.609	32	Protection of Structure	Drawings		X	
27.611	32	Inspection Provisions	Drawings		X	Design is easy to inspect.
27.613	32	Material Strength Properties and Design Values	Values used as per AR-MMPDS-01		X	
27.625	32	Fitting Factor	Analysis		X	
27.783	32	Doors	Statement in ER1002.05	X		Bike rack is located aft of cabin doors.
27.787(a)	32	Cargo and Baggage Compartments	Compliance with 23.301 through 307		X	

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
27.787(b)	32	Cargo and Baggage Compartments	Design		X	Bike rack has positive locks to secure bikes.
27.787(c) (1)	32	Cargo and Baggage Compartments	Statement in ER1002.05		X	Cargo is external to helicopter, position will not restrict escape facilities
27.807	32	Emergency Exits	Statement in ER1002.05		X	Installation does not block doors form opening
27.865	32	External Loads	N/A – Statement in CP1009			
27.1387	32	Position Light System Dihedral Angles	N/A – statement in ER1002.05			No change from Type Approval.
27.1401	32	Anticollision Light System	N/A – statement in ER1002.05			No change from Type Approval.
Subpart G – Operating Limitations and Information						
27.1505	32	Never Exceed Speed	Flight Test, Flight Manual Supplement FMS1002.92	X		V_{NE} limits to be determined by flight test
27.1525	32	Kinds of Operation	FMS1002.92	X		Limited to VFR only.
27.1529	32	Instructions for Continued Airworthiness	ICA Provided, ICA1002.90	X		
27.1557(a)	32	Miscellaneous Markings and Placards – Baggage and Cargo Compartments	Placard on rack		X	
27.1581	32	Rotorcraft Flight Manual – General	FMS1002.92	X		
27.1583(c)	32	Operating Limitations – Weight and Loading Information	FMS1002.92	X		
27.1585	32	Operating Procedures	FMS1002.92	X		
27.1587	32	Performance Information	FMS1002.92	X		
27.1589	32	Loading Information	FMS1002.92 & Placard	X		Placard installed on bike rack, instructions provided.
AWM 527 Requirements						
527.1581 (e)	3	Flight Manual – Metric Units	FMS1002.92	X		Metric units provided

APPENDIX C

CHANGED PRODUCT RULE DECISION RECORD

Aero Design Ltd. CPR Decision Record CPR-DR1002, Revision 0, 30 April 2015

CHANGED PRODUCT RULE (CPR) DECISION RECORD

NAPA No.:		
Step 1: Identify the proposed change to the aeronautical product. (Section 4.1 of AC 500-016)	The changes are detailed in the listed document(s): Certification Plan CP1002, Revision 0.	
Note: A G-1 Issue Paper may be required to track/document the decisions at Step 2 and Steps 5 through 8, and to detail the concluded certification basis.		
Step 2: Is the change substantial? (Section 4.2 of AC 500-016)	☐ Yes ☒ No	A new type certificate is required. CPR Decision Process is **Closed**. Proceed to Step 3
Step 3: Will the latest standards be used? (Section 4.3 of AC 500-016)	☐ Yes ☒ No	Certification basis to use latest standards. **Proceed to Step 8.** Proceed to Step 4.
Step 4: Group changes into related and unrelated groupings. (Section 4.4 of AC 500-016)	You may need to define the project in the format of the AC's example for Step 4. Note: For multiple groupings, continuation of this process should be split to separate decision records.	
Step 5: Is the proposed change significant? (Section 5.0 of AC 500-016)	☐ Yes ☒ No	Proceed to **Decision**. Compliance may be shown to earlier standards. Certification basis to be defined and documented as indicated (below). **Proceed to Step 8.**
Decision: Will the latest standards be used?	☐ Yes ☐ No	Certification basis to use latest standards. **Proceed to Step 8.** Proceed to Step 6, addressing each area separately (see below).
Identification of Affected Areas:	The area(s) affected by the proposed change have been detailed in Certification Plan document number(s): ~~CP1009~~ 1002, Revision 0 25 Jun 2015	
Step 6: Is this area affected by the proposed change? (Ask for each area) (Section 6.1 of AC 500-016)	☐ Yes ☐ No	Proceed to Step 7. Compliance with the latest standards is not required. Compliance may be continued to be shown with the existing certification basis.
Step 7: Do the latest standards contribute materially to the level of safety and are they practical? (Section 6.2 of AC 500-016) ☐ Continuation Sheet(s) Attached	☐ Yes ☐ No	Certification basis to be established using latest standards. Compliance with the latest standards is not required. Compliance may be shown to earlier standards. Certification Basis defined or documented as indicated in below. **Note:** Several standards may apply to each area and the assessment may differ from standard to standard. Indicate Yes if compliance with any latest standard(s) will be required. Indicate No only if earlier standards are to be applied.
Note:	A delegate may develop a proposal for the Yes/No decision of Step 7. TCCA will make the final determination.	
Step 8: Is the proposed Basis of Certification Adequate? (Section 8.0 of AC 500-016)	☒ Yes ☐ No	**Stop!** CPR Decision Process is **Closed**. Determination of Certification Basis is Complete! Basis of certification may require later airworthiness standards or Special Conditions – Consult TCCA.
Certification Basis	The certification basis is as follows or as detailed in the listed document(s): Refer to Certification Plan CP1002	

Under the delegated authority, I have examined the change in type design listed above according to established procedures and hereby determine, to the best of my knowledge and belief, that it is. (check one)

☐ substantial, pursuant to section 521.153 of the CARs
☐ significant, pursuant to subsection 521.158(3) of the CARs
☒ not significant, pursuant to subsection 521.158(3) of the CARs

James Tinson

James Tinson, DAR 304

MAY 1 2 2015

Date

Wings Project No
WPN 1507

Page 1

ENGINEERING REPORT

ER1002.05

AIRBUS HELICOPTERS EC130 B4

QUICK RELEASE BIKE RACK

COMPLIANCE REPORT

Reviewed by Jason
15/07/2015

Prepared by: Jeff Clarke, P.Tech.(Eng.)

Revision 0, 14 July 2015

Aero Design Ltd.

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TABLE OF CONTENTS

1.0 INTRODUCTION

This report details the method of compliance for the paragraphs of FAR 27 listed in Certification Plan CP1002. It includes:

- generation of the applied loads to be used for the analysis and load testing used in the structural certification of the bicycle rack.
- analysis of reactions on the mounting provisions
- certification statements related to doors and lights.

2.0 REFERENCE TEXT

Aero Design Ltd. Load Test Plan and Report TR1002.06, Revision 0, dated XX, Quick Release Bicycle Rack

Aero Design Ltd. Engineering Report ER1009.01, Revision 0, dated XX, Quick Release Cargo Basket and Mounting Provisions, approved by DAR 304

-bicycle rack uses provisions provided on the quick release mounts for the cargo basket installation.

-loads due to bicycle rack similar to cargo basket assembly

Aero Design Ltd. Load Test Plan and Report TR1009.02, Revision 0, dated XX, Quick Release Cargo Basket and Mounting Provisions

Albert C. Gross, Chester R. Kyle and Douglas J. Malewicki (1983). The Aerodynamics of Land Vehicles, Scientific American 249, no. 9

Aero Design Ltd. Installation Drawings:

100201, Revision 0 – Bicycle Rack Installation

100902, Revision 0 – Mounting Beams Installation

100903, Revision 0 – Attachment Provisions Installation

Aero Design Ltd. Fabrication Drawings:

100211, Revision 0 – Bike Rack Assembly

100215, Revision 0 – Forward Frame Assembly

100220, Revision 0 – Forward Frame Fabrication

100221, Revision 0 – Aft Frame Fabrication

100222, Revision 0 – Bushing Fabrication

100223, Revision 0 – Strap Fabrication

100230, Revision 0 – Beam Fabrication

100231, Revision 0 – Forward Bracket Fabrication

100235, Revision 0 – Attachment Bracket Fabrication

3.0 BASIS OF CERTIFICATION

Refer to Certification Plan CP1002, Revision 1, Section 5.5 for the applicable basis of certification.

4.0 LOADS

4.1 Load Factors

Quick Release Bike Rack - EC130

FAR 27.561(b)(3)		
	Ultimate Upward Emergency Landing Load Factor:	$n_{e\_up} := 1.5$
	Ultimate Forward Emergency Landing Load Factor:	$n_{e\_fwd} := 4.0$
	Ultimate Sideward Emergency Landing Load Factor:	$n_{e\_side} := 2.0$
	Ultimate Downward Emergency Landing Load Factor:	$n_{e\_down} := 4.0$
FAR 27.625	Fitting Factor (does not apply to articles being tested):	$n_{ff} := 1.15$
FAR 27.303	Safety Factor:	$n_{sf} := 1.5$
FAR 27.337(a)		
	Limit Positive Maneuvering Load Factor:	$n_{man} := 3.5$
$n_{man\_ult} := n_{man} \cdot n_{sf}$	Ultimate Positive Maneuvering Load Factor:	$n_{man\_ult} = 5.25$
	Limit Negative Maneuvering Load Factor:	$n_{man\_neg} := -1.0$
$n_{man\_neg\_u} := n_{man\_neg} \cdot n_{sf}$	Ultimate Negative Maneuvering Load Factor:	$n_{man\_neg\_u} = -1.5$

CRITICAL ULTIMATE LOAD FACTORS:

Downward:	Ultimate Positive Maneuvering Load Factor:	$n_{man\_ult} = 5.25$
Forward:	Ultimate Forward Emergency Landing Load Factor:	$n_{e\_fwd} = 4$
Sideward:	Ultimate Sideward Emergency Landing Load Factor:	$n_{e\_side} = 2$
Upward:	Ultimate Upward Emergency Landing Load Factor:	$n_{e\_up} = 2$

Note: The bike rack is mounted below and to one side of the cabin. Forward deflection or failure in the emergency landing condition does not endanger the occupants. Likewise, Sideward and Upward deflection or failure of the bike rack in the emergency landing condition do not endanger the occupants.

Sideward and Upward Load Factors are used in the tests to ensure that the bikes remain secured in flight.

4.2 Loads Overview

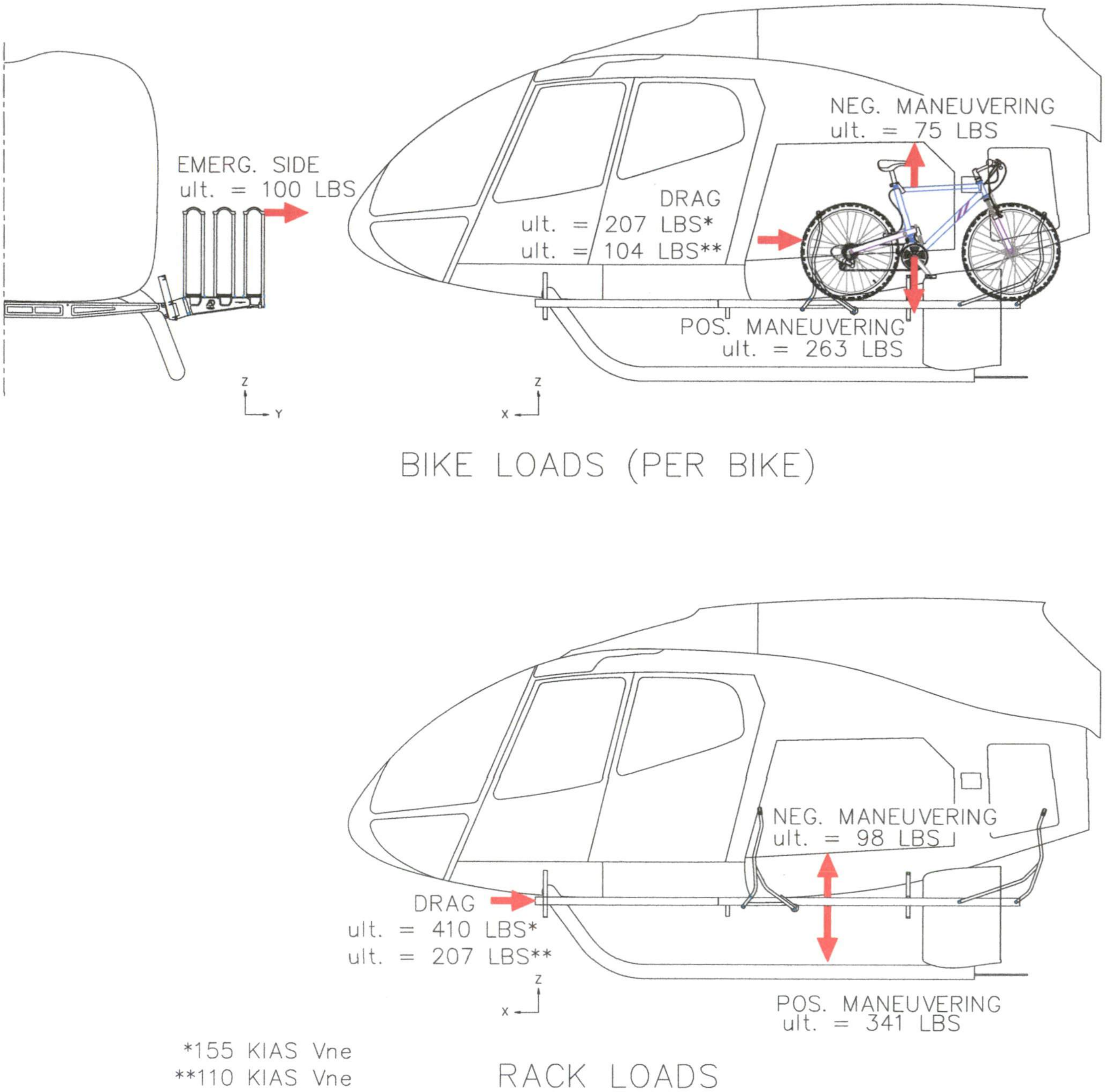

Figure 4.2.1 – Overview of Applied Loads

4.3 Inertia Loads

4.3.1 Weights

It is expected the bikes will average 35-40 lbs when equipped for the type of riding to be performed when dropped off by helicopter. The racks will be limited by placard and flight manual supplement to 130 lbs total per rack with 50 lbs maximum per bike to allow for the possibility of 1 heavy bike per side.

$W_{rack} := 65 \cdot lbf$ Weight of bike rack

$W_{bike1} := 40 \cdot lbf$ Weight of bike (max, inboard)

$W_{bike2} := 40 \cdot lbf$ Weight of bike (max, centre)

$W_{bike3} := 50 \cdot lbf$ Weight of bike (max, outboard)

4.3.2 Positive Maneuvering Load

Bike rack only:

$P_{man\_lim\_rack} := W_{rack} \cdot n_{man\_lim}$

$P_{man\_lim\_rack} = 227 \cdot lbf$ Limit positive maneuvering load due to rack

$P_{man\_ult\_rack} := P_{man\_lim\_rack} \cdot n_{sf}$

$P_{man\_ult\_rack} = 341 \cdot lbf$ Ultimate positive maneuvering load due to rack

Bike 1 and 2 – 40 lbs (inboard and centre positions)

$P_{man\_lim\_bike1} := (W_{bike1}) \cdot n_{man\_lim}$

$P_{man\_lim\_bike1} = 140 \cdot lbf$ Limit positive maneuvering load due to bike only

$P_{man\_ult\_bike1} := P_{man\_lim\_bike1} \cdot n_{sf}$

$P_{man\_ult\_bike1} = 210 \cdot lbf$ Ultimate positive maneuvering load due to bike only

Bike 3 – 50 lbs (outboard position, critical for maximum load)

$P_{man\_lim\_bike3} := (W_{bike3}) \cdot n_{man\_lim}$

$P_{man\_lim\_bike3} = 175 \cdot lbf$ Limit positive maneuvering load due to bike only

$P_{man\_ult\_bike3} := P_{man\_lim\_bike3} \cdot n_{sf}$

$P_{man\_ult\_bike3} = 263 \cdot lbf$ Ultimate positive maneuvering load due to bike only

4.3.3 Negative Maneuvering Load / Upward Emergency Landing Load

The ultimate negative maneuvering load and emergency upward load factors are the same. The individual bicycle rack assemblies must restrain the bicycle under this condition, and the entire assembly must support the loads back to the attachments.

$P_{man\_neg\_lim\_rack} := W_{rack} \cdot n_{man\_neg}$

$P_{man\_neg\_lim\_rack} = -65 \cdot lbf$ Limit negative maneuvering load due to rack

$P_{man\_neg\_ult\_rack} := P_{man\_neg\_lim\_rack} \cdot n_{sf}$

$P_{man\_neg\_ult\_rack} = -98 \cdot lbf$ Ultimate negative maneuvering load due to rack

$P_{man\_neg\_lim\_bike} := (W_{bike3}) \cdot n_{man\_neg}$

$P_{man\_neg\_lim\_bike} = -50 \cdot lbf$ Limit negative maneuvering load due to bike only

$P_{man\_neg\_ult\_bike} := P_{man\_neg\_lim\_bike} \cdot n_{sf}$

$P_{man\_neg\_ult\_bike} = -75 \cdot lbf$ Ultimate negative maneuvering load due to bike only

4.3.4 Sideward Emergency Landing Load

The individual bicycles must be restrained under the sideward emergency landing load.

$P_{e\_side} := W_{bike3} \cdot n_{e\_side}$

$P_{e\_side} = 100 \cdot lbf$ Ultimate sideware load on each bike

4.4 Aerodynamic Loads

4.4.1 Drag Load

DRAG LOAD ON BIKE RACK - Basic aircraft Vne

$A_{f\_rack} := 196 \cdot in^2 = 1.4 \cdot ft^2$ Frontal Area of bike rack

$C_{Do} := 2.0$ Drag Coefficient of Rack, (overestimated)
(Square tubes and flat mounting beam perpendicular to airflow)

$\rho := 0.002378 \cdot \frac{slug}{ft^3}$ Density of air at Sea Level.

$V_{ne} := 155 \cdot knots = 262 \cdot \frac{ft}{s}$ Never-Exceed-Speed of EC130 B4
(Ref. TCDS H-83.)

$$V_d := \frac{V_{ne}}{0.9}$$

$V_d = 172 \cdot \text{knots} = 291 \frac{\text{ft}}{\text{s}}$ Design Dive Speed of EC130 B4

$$P_{drag\_lim\_rack} := \frac{\rho}{2} \cdot V_d^{\ 2} \cdot A_{f\_rack} \cdot C_{Do}$$

$P_{drag\_lim\_rack} = 273 \cdot \text{lbf}$ Limit Drag load on bike rack (empty)

$$P_{drag\_ult\_rack} := P_{drag\_lim\_rack} \cdot n_{sf}$$

$P_{drag\_ult\_rack} = 410 \cdot \text{lbf}$ Ultimate Drag load on bike rack (empty)

DRAG LOAD ON BIKES - Basic aircraft Vne

$A_{f\_bike} := 180 \cdot \text{in}^2 = 1.3\,\text{ft}^2$ Frontal Area of bike

$C_{Do} := 1.1$ Drag Coefficient of bike
Ref: The Aerodynamics of Human-powered Land Vehicles
by Gross, Kyle and Malewicki
Human Powered Vehicle Performance - Dragless Human
(Chart in Appendix A)

$$P_{drag\_lim\_bike} := \frac{\rho}{2} \cdot V_d^{\ 2} \cdot A_{f\_bike} \cdot C_{Do}$$

$P_{drag\_lim\_bike} = 138 \cdot \text{lbf}$ Limit Drag load on bike (each)

$$P_{drag\_ult\_bike} := P_{drag\_lim\_bike} \cdot n_{sf}$$

$P_{drag\_ult\_bike} = 207 \cdot \text{lbf}$ Ultimate Drag load on bike (each)

Combined drag due to rack and bikes

$$P_{drag\_lim} := P_{drag\_lim\_rack} + 3 \cdot P_{drag\_lim\_bike}$$

$P_{drag\_lim} = 688 \cdot \text{lbf}$ Limit drag load (bike rack and 3 bikes)

$$P_{drag\_ult} := P_{drag\_ult\_rack} + 3 \cdot P_{drag\_ult\_bike}$$

$P_{drag\_ult} = 1032 \cdot \text{lbf}$ Ultimate drag load (bike rack and 3 bikes)

At the basic aircraft V_{NE}, the drag loads on the bikes and rack are significantly higher than the cargo basket installation at 510 lbs using the same mounting provisions, reference Engineering Report ER1009.01. To bring the drag loads more in line with the cargo basket loads, the V_{NE} of the aircraft is limited to 110 KIAS with the bike racks loaded. Drag on the empty rack at the basic aircraft V_{NE} is lower than the basket and therefore does not require reduction.

DRAG LOAD ON BIKE RACK - reduced Vne

$A_{f\_rack} := 196 \cdot in^2 = 1.4 \cdot ft^2$ Frontal Area of bike rack

$C_{Do} := 2.0$ Drag Coefficient of Rack, (overestimated)
(Square tubes and flat mounting beam perpendicular to airflow)

$\rho := 0.002378 \cdot \frac{slug}{ft^3}$ Density of air at Sea Level.

$V_{ne} := 110 \cdot knots = 186 \cdot \frac{ft}{s}$ Never-Exceed-Speed of with bike rack installed

$V_d := \frac{V_{ne}}{0.9}$

$V_d = 122 \cdot knots = 206 \frac{ft}{s}$ Design Dive Speed with bike rack installed

$P_{drag\_lim\_rack} := \frac{\rho}{2} \cdot V_d^2 \cdot A_{f\_rack} \cdot C_{Do}$

$P_{drag\_lim\_rack} = 138 \cdot lbf$ Limit Drag load on bike rack (empty)

$P_{drag\_ult\_rack} := P_{drag\_lim\_rack} \cdot n_{sf}$

$P_{drag\_ult\_rack} = 207 \cdot lbf$ Ultimate Drag load on bike rack (empty)

DRAG LOAD ON BIKES - reduced Vne

$A_{f\_bike} := 180 \cdot in^2 = 1.3 ft^2$ Frontal Area of bike

$C_{Do} := 1.1$ Drag Coefficient of bike
Ref: The Aerodynamics of Human-powered Land Vehicles
by Gross, Kyle and Malewicki
Human Powered Vehicle Performance - Dragless Human

$P_{drag\_lim\_bike} := \frac{\rho}{2} \cdot V_d^2 \cdot A_{f\_bike} \cdot C_{Do}$

$P_{drag\_lim\_bike} = 70 \cdot lbf$ Limit Drag load on bike (each)

$P_{drag\_ult\_bike} := P_{drag\_lim\_bike} \cdot n_{sf}$

$P_{drag\_ult\_bike} = 104 \cdot lbf$ Ultimate Drag load on bike (each)

Combined drag due to rack and bikes

$P_{drag\_lim} := P_{drag\_lim\_rack} + 3 \cdot P_{drag\_lim\_bike}$

$P_{drag\_lim} = 346 \cdot lbf$ Limit drag load (bike rack and 3 bikes)

$P_{drag\_ult} := P_{drag\_ult\_rack} + 3 \cdot P_{drag\_ult\_bike}$

$P_{drag\_ult} = 520 \cdot lbf$ Ultimate drag load (bike rack and 3 bikes)

5.0 STRUCTURAL ANALYSIS

The unloaded bike rack does not exceed the loads demonstrated for the cargo basket configuration using the same mounts, reference Engineering Report ER1009.02.

5.1 Combined Positive Maneuvering and Drag Load Condition

Structural compliance for the bicycle rack assembly and mounting provisions in the positive maneuvering condition are demonstrated by test, see load test plan and report TR1002.06.

The tube section of the rack must restrain each bike under the drag condition. The rack cannot open or otherwise deform sufficiently to allow the bike to be released from the rack when subjected to drag loads up to the ultimate drag load. The required applied loads are:

$P_{drag\_ult\_bike}$ = 104 lbs	Ultimate drag load on bike

The rack and mounting provisions must support the positive maneuvering loads and drag loads due to the rack and bikes combined. The required applied loads are:

$P_{man\_lim\_rack}$ = 227 lbs	Limit positive maneuvering load due to rack
$P_{man\_lim\_bike1}$ = 140 lbs	Limit positive maneuvering load due to inboard bike
$P_{man\_lim\_bike2}$ = 140 lbs	Limit positive maneuvering load due to centre bike
$P_{man\_lim\_bike3}$ = 175 lbs	Limit positive maneuvering load due to outboard bike
P_{drag_lim} = 346 lbs	Limit drag load

$P_{man\_ult\_rack}$ = 341 lbs	Ultimate positive maneuvering load due to rack
$P_{man\_ult\_bike1}$ = 210 lbs	Ultimate positive maneuvering load due to inboard bike
$P_{man\_ult\_bike2}$ = 210 lbs	Ultimate positive maneuvering load due to centre bike
$P_{man\_ult\_bike3}$ = 263 lbs	Ultimate positive maneuvering load due to outboard bike
P_{drag_ult} = 520 lbs	Ultimate drag load

5.2 Negative Maneuvering Load Condition

Structural compliance for the bicycle rack assembly in the negative maneuvering condition is demonstrated by test, reference Load Test Plan and Report TR1002.06.

The bike must be retained by the rack in the ultimate negative maneuvering condition. The required applied load is:

$P_{man\_neg\_ult\_bike}$ = 75 lbs	Ultimate negative maneuvering load due to bike on rack

The base of the rack must transfer the applied negative maneuvering load to the attachments. The required applied loads are:

$P_{man\_neg\_lim\_rack}$ = 65 lbs	Limit negative maneuvering load due to bike rack
$P_{man\_neg\_ult\_rack}$ = 98 lbs	Ultimate negative maneuvering load due to bike rack

$P_{man\_neg\_lim\_bike}$ = 50 lbs	Limit negative maneuvering load due to bike on rack
$P_{man\_neg\_ult\_bike}$ = 75 lbs	Ultimate negative maneuvering load due to bike on rack

The stainless steel tube section of the mounting beams is symmetrical, therefore the bending moment applied to the tube by the positive maneuvering condition is sufficient to demonstrate the negative maneuvering condition.

The aluminum section of the mounting beams is symmetrical, therefore the bending moment applied to the aluminum beam by the positive maneuvering condition is sufficient to demonstrate the negative maneuvering condition.

The fasteners attaching the stainless steel tube section to the aluminum beam have been demonstrated to support the positive maneuvering condition, which is sufficient to demonstrate the negative maneuvering condition.

5.3 Forward Emergency Landing Load Condition

The bike rack is located below the cabin. Forward deflection of the bike rack does not endanger the occupants in a crash. The rack on the inboard rail is limited in forward movement by the support beam for the outboard rails at a position that will not block the cabin doors.

5.4 Upward Emergency Landing Load Condition

The bike rack is located aft of the cabin. Deflection in the upward direction does not endanger the occupants in a crash. The negative maneuvering load condition is critical.

5.5 Sideward Emergency Landing Load Condition

The bicycles must be restrained by the rack in the sideward emergency landing condition. This condition is demonstrated by test, reference Load Test Plan and Report TR1002.06. The required applied load is:

P_{e_side} = 100 lbs Ultimate side load due to bike

5.6 Helicopter Attachments

The critical load condition is the positive maneuvering load combined with drag. The reactions on the airframe are shown on figures 5.6.1 through 5.6.3.

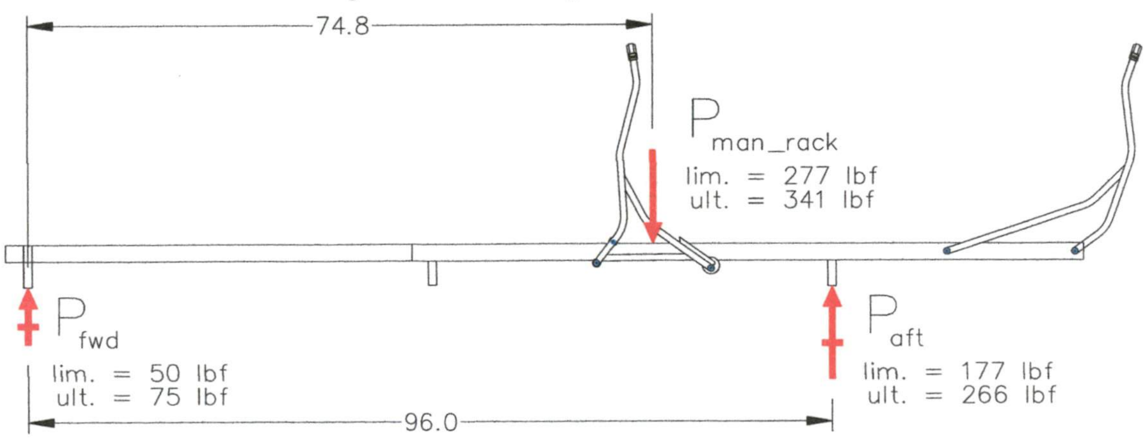

Figure 5.6.1 – Load Distribution – Bike Rack Only

Sum moments about forward end:

$$P_{aft} := \frac{P_{man\_ult\_rack} \cdot 74.8 \cdot in}{96.0 \cdot in}$$

$P_{aft} = 266 \cdot lbf$ Ultimate reaction due to rack distributed to aft attachment

$P_{fwd} := P_{man\_ult\_rack} - P_{aft}$

$P_{fwd} = 75 lbf$ Ultimate reaction due to rack distributed to forward attachment

The loads applied by the bikes on the rack are located at the aft attachment for smaller bikes and moving forward as the tire and frame size increases. The shift forward will distribute more of the load to the forward attachment but it will remain lightly loaded compared to the aft attachment. The aft beam is critical.

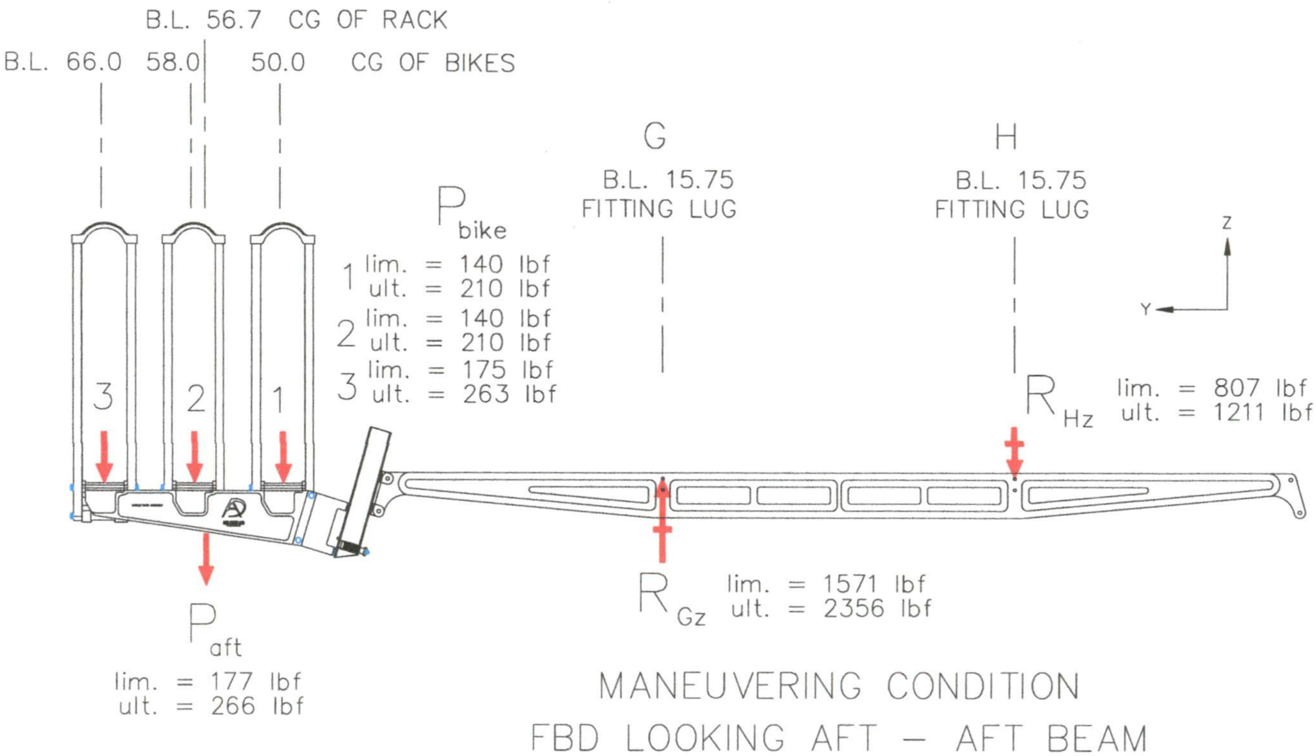

Figure 5.6.2 – Helicopter Reactions – Maneuvering Load, Aft Beam

Sum moments about G:

$$R_{Hz} := \frac{P_{aft} \cdot 41.0 \cdot in + P_{man\_ult\_bike1} \cdot 34.1 \cdot in + P_{man\_ult\_bike2} \cdot 42.1 \cdot in + P_{man\_ult\_bike3} \cdot 50.1 \cdot in - P_{man\_ult\_beam} \cdot 15.75 in}{31.5 \cdot in}$$

$R_{Hz} = 1211 \cdot lbf$ Ultimate vertical reaction at H

Sum forces vertically:

$$R_{Gz} := R_{Hz} + P_{man\_ult\_rack} + P_{man\_ult\_bike1} + P_{man\_ult\_bike2} + P_{man\_ult\_bike3} + P_{man\_ult\_beam}$$

$R_{Gz} = 2356 \cdot lbf$ Ultimate vertical reaction at G

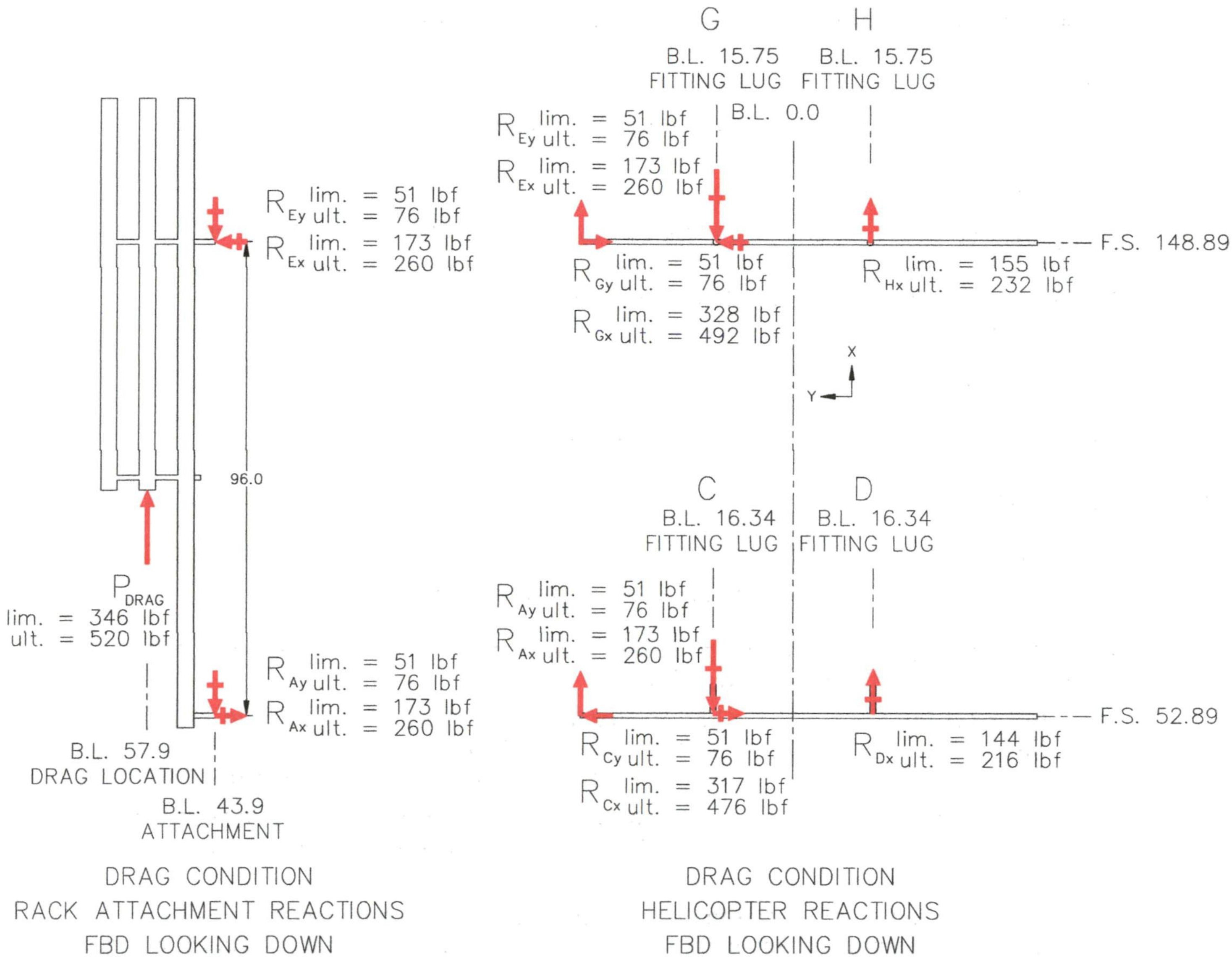

Figure 5.6.3 – Helicopter Reactions – Drag Load

Drag reactions on rack attachment. Drag load is divided equally between the forward and aft attachments. Sum moments about forward end.

$$R_{Ey} := \frac{P_{drag\_ult} \cdot 14.0 \cdot in}{96.0 \cdot in}$$

$R_{Ey} = 76 \cdot lbf$ Ultimate lateral reaction at aft attachment

Sum forces vertically:

$R_{Ay} := R_{Ey}$

$R_{Ay} = 76 \cdot lbf$ Ultimate lateral reaction at forward attachment

The drag load is equally distributed between the forward and aft attachments:

$$R_{Ex} := \frac{P_{drag\_ult}}{2}$$

$R_{Ex} = 260 \cdot \text{lbf}$ Ultimate longitudinal reaction at aft rack attachment

$$R_{Ax} := R_{Ex}$$

$R_{Ax} = 260 \cdot \text{lbf}$ Ultimate longitudinal reaction at forward rack attachment

Drag reactions on airframe - aft is critical as attachments are closer together.
Sum moments about G:

$$R_{Hx} := \frac{R_{Ex} \cdot 28.1 \cdot \text{in}}{31.5 \cdot \text{in}}$$

$R_{Hx} = 232 \cdot \text{lbf}$ Ultimate horizontal reaction at H

Sum forces horizontally:

$$R_{Gx} := R_{Hx} + R_{Ex}$$

$R_{Gx} = 492 \cdot \text{lbf}$ Ultimate horizontal reaction at G

Using the loads applied by the cargo basket installation as the allowable loads, reference Engineering Report ER1009.01, Section 5.6:

R_{Gx} = 469 lbs	Longitudinal reaction at G due to cargo basket installation
R_{Gy} = 78 lbs	Lateral reaction at G due to cargo basket installation
R_{Gz} = 2330 lbs	Vertical reaction at G due to cargo basket installation
R_{Hx} = -214 lbs	Longitudinal reaction at H due to cargo basket installation
R_{Hz} = -1225 lbs	Vertical reaction at H due to cargo basket installation

The reactions on the airframe due to the bike rack installation determined above exceed the loads applied by the cargo basket installation by 1% in the Z (vertical) direction and 5% in the X (longitudinal) direction. This is acceptable because:

- With the reduced Vne the ultimate maneuvering loads cannot be achieved.
- The analysis ignores any support provided by the forward end.
- A 50 lb bike for this operation is considered to be very rare.
- The 50 lb bike is located at the most critical outboard position; locating it at the most inboard position reduces the vertical load on the airframe below the cargo basket load.
- The reactions on the airframe are reduced significantly when racks are installed on both sides, which is normal for this operation. Reference Engineering Report ER1009.01, Section 5.7 for comparison of dual basket installation.

5.7 Dual Rack Installation

This installation will normally be applied to both sides of the helicopter simultaneously. Dual installation was considered for the cargo basket configuration, reference Engineering Report ER1009.01, Section 5.7, and found to be acceptable. This installation has virtually identical loads to the cargo basket configuration, therefore dual installation of the bike racks is acceptable.

6.0 COMPLIANCE WITH FAR 27.783 – DOORS

(a) Each closed cabin must have at least one adequate and easily accessible external door.

No change from Type Approved configuration.

The bike rack is located well below the doors, with the forward section replacing the cabin step. The bikes are located aft of the cabin doors. The bikes do not interfere with the standard (outward swing) doors for the forward cabin. The loading procedure in the FMS requires the inboard bike to be oriented with the handle bars aft, which will put the widest part of the bike aft of the sliding cabin door when fully open. The handle on the sliding door remains extended while the door is open, and clears the rack assembly.

Figure 6.0.1 – Bike Rack Installed

(b) Each external door must be located where persons using it will not be endangered by the rotors, propellers, engine intakes, and exhausts when appropriate operating procedures are

used. If opening procedures are required, they must be marked inside, on or adjacent to the door opening device.

No change from Type Approved configuration.

7.0 COMPLIANCE WITH FAR 27.787 – CARGO COMPARTMENTS

(b) There must be means to prevent the contents of any compartment from becoming a hazard by shifting under the loads specified in paragraph (a) of this section.

The bikes are secured with frame that locks to the rack with 3 rollers and a cam action, see figure 7.0.1. The rack is tested to demonstrate it can restrain the loads specified in paragraph (a) in Test Plan and Report TR1002.06.

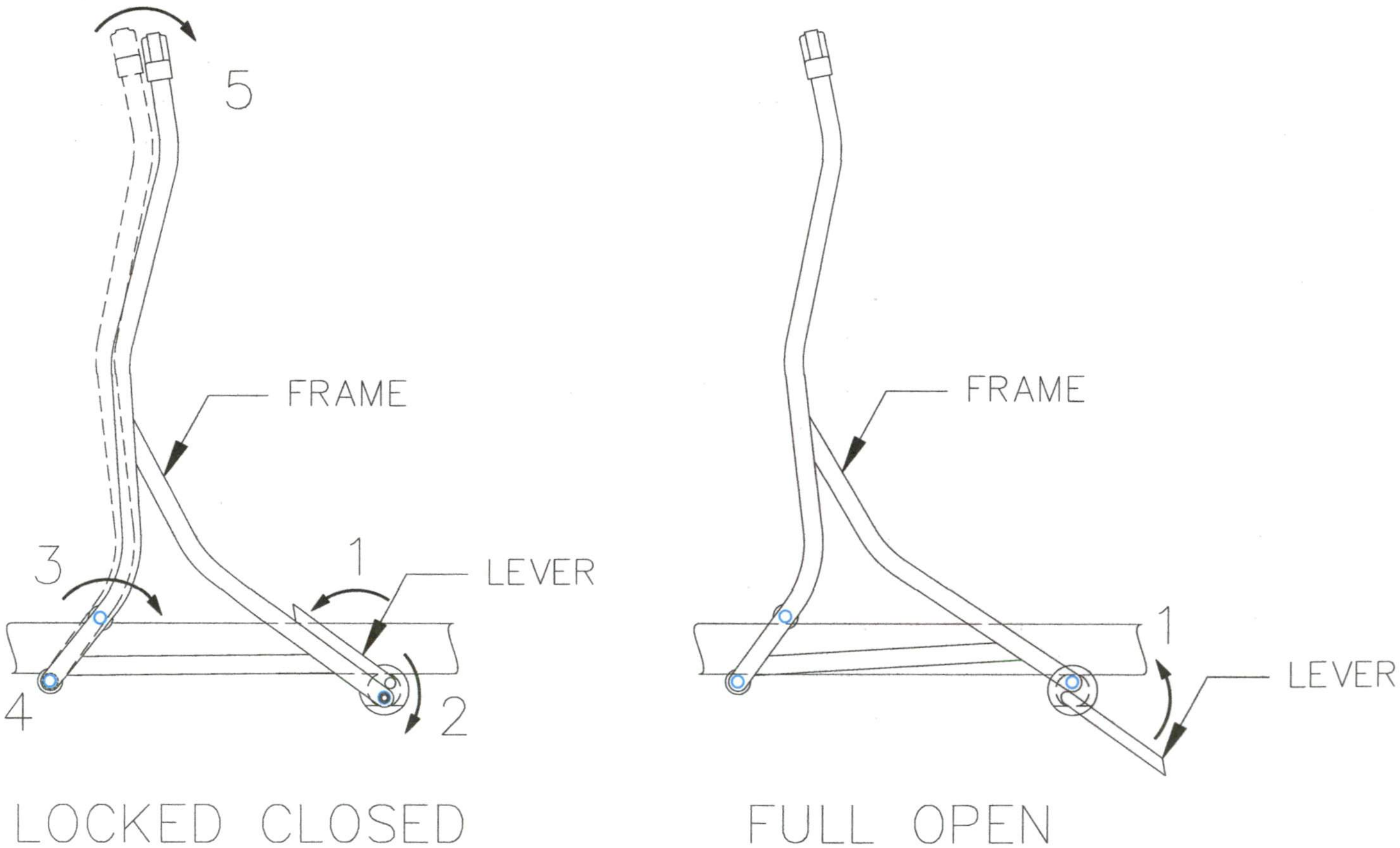

Figure 7.0.1 – Cam Action

The cam action applies pressure to the bike rack, securing the bike, as follows:

1. The lever begins in the full open position. There is a flat on the cam (reference drawing 100222) in both the open and closed positions to retain the lever in the set position. The frame can be moved along the rack as required when in the open position.
2. As the lever is rotated to the closed position, the cam increases the distance from the axis of the cam to the bottom of the rack at point 2, rotating the frame down between the rollers on the opposite end (points 3 and 4).
3. As the frame rotates the vertical distance between points 3 and 4 is reduced until there is interference between the rollers and the rack, clamping the rollers to the rack.

4. The top of the rack at point 5 rotates aft (1.2") and down (0.25") into the bike tire, locking the bike into the rack.
5. As the lever reaches the locked closed position, a flat on the cam is pressed against the bottom of the rack.

A minimum of 10 lbs is required to rotate the lever from the locked closed position. This greatly exceeds the inertia of the lever.

The locking mechanism is tested in TR1002.06 to ensure the mechanism continues to provide sufficient clamping force when lubricating or abrasive contaminants are applied. Contaminants to include: WD-40, Mobil Grease 28, talcum powder, and fine abrasive dust (eg. glass bead or sand).

Forward loading on the top of the frame increases the squeezing action between rollers 3 and 4, increasing the clamp up pressure.

The mechanism is not dependent on having a tire in the frame to lock. The frames are locked in place on the rack when the rack is not loaded. If the frames are not locked in place, they are prevented from moving forward next to the cabin by the forward mounting beam.

(c) Under the emergency landing conditions of Sec. 27.561, cargo and baggage compartments must--
(1) Be positioned so that if the contents break loose they are unlikely to cause injury to the occupants or restrict any of the escape facilities provided for use after an emergency landing; or

The bike rack is located outside of the main cabin and is not in a position to cause injury to the occupants. The bikes are located aft of the main cabin doors and are not in a position to prevent opening of the cabin doors. The forward cabin doors are jettisonable from the inside.

8.0 COMPLIANCE WITH FAR 27.807 – EMERGENCY EXITS

(a) Number and location. Rotorcraft with closed cabins must have at least one emergency exit on the opposite side of the cabin from the main door.

No change from Type Approved configuration.

(b) Type and operation. Each emergency exit prescribed in paragraph (a) of this section must—

(1) Consist of a movable window or panel, or additional external door, providing an unobstructed opening that will admit a 19- by 26-inch ellipse;

No change from Type Approved configuration. Forward cabin doors are jettisonable.

(2) Be readily accessible, require no exceptional agility of a person using it, and be located so as to allow ready use, without crowding, in any probable attitudes that may result from a crash;

No change from Type Approved configuration.

(3) Have a simple and obvious method of opening and be arranged and marked so as to be readily located and operated, even in darkness; and

No change from Type Approved configuration.

(4) Be reasonably protected from jamming by fuselage deformation.
No change from Type Approved configuration.

(c) Tests. The proper functioning of each emergency exit must be shown by test.
No change from Type Approved configuration.
(d) Ditching emergency exits for passengers.
Not applicable.

9.0 COMPLIANCE WITH FAR 27.1387, .1401 – LIGHTS

The external lighting system consists of:
Landing and taxi lights on the bottom fairings (1 and 6)
Position lights at the ends of the horizontal stabilizer (2, 5)
Position light on top of the fin (4)
Anticollision light on the fin fairing (3)

Installation of the quick release bicycle rack does not block these lights.

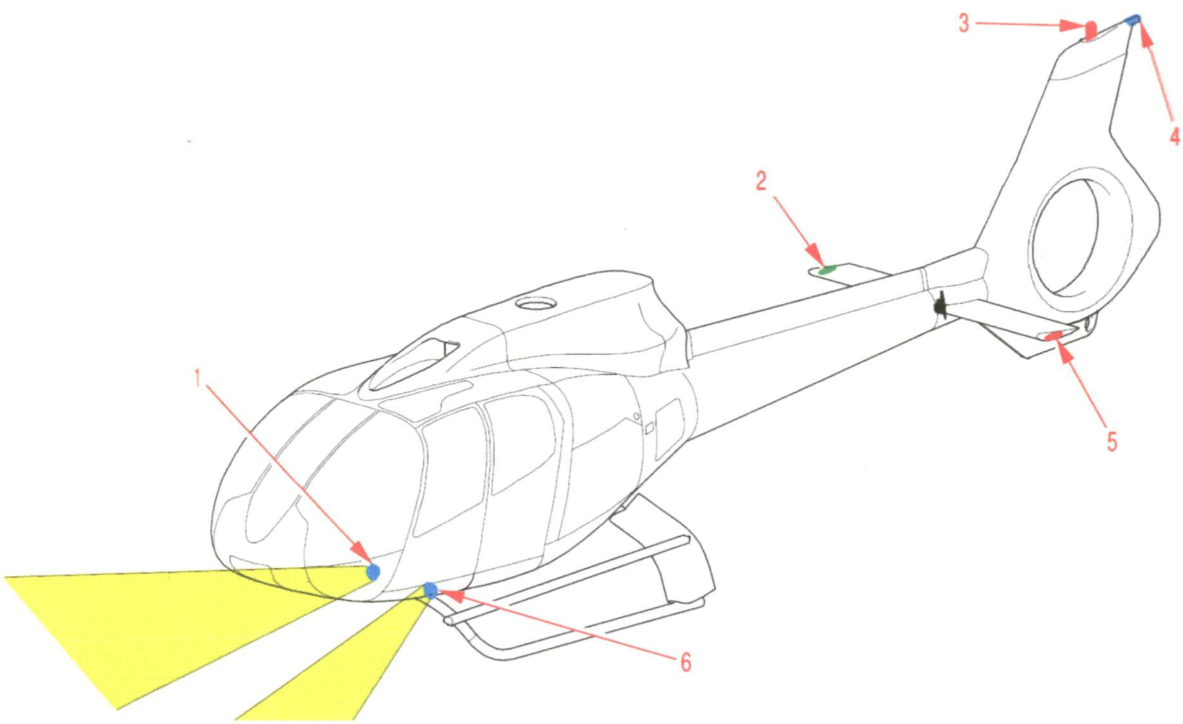

Figure 7.0.1 – External Lighting Locations

APPENDIX A

HUMAN POWERED VEHICLE PERFORMANCE CHART

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HUMAN POWERED VEHICLE PERFORMANCE

	DESCRIPTION		FORCES AT 20 MPH (POUNDS) Aerodynamic Pressure ≈ about 1 LB/FT²	AERODYNAMIC DATA			ROLLING RESISTANCE COEFFICIENT C_R	LEVEL GROUND, NO WINDS			EFFECT OF HILLS	
				DRAG COEFFICIENT C_D	FRONTAL AREA (FT²) A	EFFECTIVE FRONTAL AREA (FT²) C_DA		HORSEPOWER REQUIRED AT 20 MPH AS A PERCENTAGE OF THE TOURING (ARMS STRAIGHT) BICYCLIST	ALL DAY TOURING SPEED AT 0.1 HORSE-POWER OUTPUT (MPH)	MAXIMUM SPEED WITH 1.0 HORSE-POWER OUTPUT (MPH)	STEADY SPEED UP A 5% GRADE AT 0.4 HORSE POWER OUTPUT (MPH)	STEADY SPEED COASTING DOWN A 5% GRADE (MPH)
STANDARD BICYCLES	BMX (YOUTH OFF ROAD RACER)	30 LB BIKE 120 LB RIDER 20" DIA 40PSI KNOBBY TIRES	AIR 5.52 2.10	1.1	4.9	5.4	.014	146%	10.1	27.8	12.2	19.8
	EUROPEAN UPRIGHT COMMUTER	40 LB BIKE 160 LB RIDER 27" DIA 40 PSI TIRES	AIR 6.14 1.20	1.1	5.5	6.0	.006	140%	11.3	27.6	10.9	24.0
	TOURING (ARMS STRAIGHT)	25 LB BIKE 160 LB RIDER 27" DIA 90 PSI CLINCHER TIRES	AIR 4.40 .83	1.0	4.3	4.3	.0045	100%	13.1	31.1	12.2	27.7
	RACING (FULLY CROUCHED)	20 LB BIKE 160 LB RIDER 27" DIA 105 PSI SEWUP TIRES	AIR 3.48 .54	.88	3.9	3.4	.003	77%	14.7	33.9	13.0	31.2
PROVEDPRODUCTION	AEROCOMPONENT (FULLY CROUCHED)	20 LB BIKE 160 LB RIDER 27" DIA. 105 PSI SEWUP TIRES	AIR 3.27 .54	.83	3.9	3.2	.003	73%	15.0	34.6	13.0	32.2
	PARTIAL FAIRING (ZZIPPER) CROUCHED	21 LB BIKE 160 LB RIDER 27" DIA 105 PSI SEWUP TIRES	AIR 2.97 .54	.70	4.1	2.9	.003	67%	15.4	35.7	13.1	33.9
	RECUMBENT (EASY RACER)	27 LB BIKE 160 LB RIDER 27" REAR 20" FRONT 90 PSI CLINCHERS	AIR 2.97 .94	.77	3.8	2.9	.005	75%	14.4	35.2	12.5	33.7
	TANDEM	42 LB BIKE TWO 160 LB RIDERS 27" DIA 90 PSI CLINCHERS (181 LBS PER PERSON)	AIR 5.32 (2.66) 1.62 (.81)	1.0	5.2	5.2 (2.6 per person)	.0045	66%	15.2	36.6	13.0	35.2
	DRAFTING CLOSELY FOLLOWING ANOTHER BICYCLIST	20 LB BIKE 160 LB RIDER 27" DIA 105 PSI SEWUP TIRES	AIR 1.94 .54	.50	3.9	1.9	.003	47%	17.5	41.0	13.6	41.7
RECORD HPV'S	BLUE BELL 2 WHEELED SINGLE RIDER	40 LB BIKE 160 LB RIDER 27" REAR 20" FRONT 105 PSI SEWUPS	AIR .61 .80	.12	7.3 5.0	.6	.004	27%	22.5	58.6	12.9	77.4
	KYLE 2 WHEELED TWO RIDERS	52 LB BIKE TWO 160 LB RIDERS 105 PSI SEWUPS (186 LBS PER PERSON)	AIR 1.44 (.72) 1.12 (.56)	.2	7.0	1.4 (.7 per person)	.003	24%	23.3	56.6	14.0	69.9
	VECTOR SINGLE TRIKE	68 LB BIKE 160 LB RIDER SEWUPS 27" REAR 24" FRONT	AIR .51 1.02	.11	4.56	.5	.0045	29%	21.8	61.2	11.3	90.1
	VECTOR TANDEM TRIKE	75 LB BIKE TWO 160 LB RIDERS 24" SEWUPS (198 LBS PER PERSON)	AIR .62 (.31) 1.78 (.89)	.13	4.7	.6 (.3 per person)	.0045	23%	25.6	72.5	13.0	108.4
RETICAL LIMITS	PERFECT BIKE	NO ROLLING RESISTANCE ZERO DRAG ON ENTIRE BIKE DRAG OF HUMAN ONLY IN TOURING POSITION	AIR 3.07 0	.8	3.8	3.0	0	59%	16.7	35.9	13.4	34.7
	DRAGLESS HUMAN	ZERO DRAG ON HUMAN DRAG OF BIKE ONLY ROLLING RESISTANCE INCLUDES HUMANS WEIGHT	AIR 1.33 .81	1.1	1.2	1.3	.0045	41%	18.4	45.8	13.3	50.3
	PERFECT RECUMBENT	DRAG ON FLAT ON BACK HUMAN ONLY	AIR .72 0	.6	1.2	.7	0	14%	27.1	58.3	16.8	66.9
	PERFECT PRONE BIKE	DRAG ON 109 LB SMALL BUT POWERFUL HUMAN ONLY	AIR .51 0	.6	.8	.5	0	10%	30.4	65.3	23.2	65.3
	PERFECT PRONE STREAMLINER		AIR .07 0	.05	1.4	.07	0	1%	58.3	125.9	[illegible]5.6	174.5
TH	MOTOR PACED	42 LB BIKE 160 LB RIDER (VEHICLE BREAKS AIR FOR RIDER) 70 PSI MOTORCYCLE ROAD RACING TIRES	AIR 0 1.21	—	—	VARIES WITH SPEED (MINUS OVER 1.0 MPH)	.006	23%	29.4	294.0	12.6	∞
	MOON BIKE 1/6 g ENVIRONMENT	25 LB BIKE 160 LB RIDER 15 LB SPACE SUIT 27" DIA 90 PSI CLINCHERS	AIR 0 .15	—	—	0	.0045	3%	237.5	2,375.	78.4	∞

FLIGHT TEST PLAN

FTP1002.07

AIRBUS HELICOPTERS EC130 B4

QUICK RELEASE BICYCLE RACK

Reviewed by Jason
15/07/2015

Prepared by: J. Clarke, P.Tech.(Eng.)

Revision 0, 15 July 2015

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TABLE OF CONTENTS

1.0 INTRODUCTION

The Quick Release Bicycle Rack is mounted on the right and/or left side of the helicopter. The bike rack is made of aluminum extruded rails with stainless steel tubing frames to support the bikes. It is quickly detachable from the mounting beams that support it.

Each bike is secured with a fixed frame and a moveable frame to allow for adjustment. The moveable frame is secured with a positive locking cam action.

2.0 REFERENCE TEXT

Aero Design Ltd. Installation Drawings

100202, Revision 0 – Quick Release Bicycle Rack Installation

100902, Revision 0 – Quick Release Mounting Provisions Installation

100903, Revision 0 – External Attachment Provisions Installation

101001, Revision 0 – Quick Release Cabin Step Installation

Aero Design Ltd. Flight Manual Supplement FMS1002.91 Revision 0 (draft)

Airbus Helicopters EC130 B4 Rotorcraft Flight Manual

3.0 FLIGHT TEST OBJECTIVE

Flight testing of the Quick Release Cargo Basket is meant to demonstrate the following:

- the installation is free of excessive vibration at speeds from hover thru to V_d;
- the installation does not produce undesirable effects to the handling and performance qualities of the helicopter;

This flight testing is in advance of flight testing by Transport Canada Flight Test Division in support of obtaining a Supplemental Type Certificate.

4.0 TEST PREPARATION

4.1 Instrument Calibration

The maintenance records of the test helicopter will be checked to ensure the airspeed indicator has been calibrated within the specified time period.

4.2 Equipment

1. The helicopter will be fitted with the Quick Release Mounting Provisions Installation in accordance with drawing 100902 and 100903 for the configurations specified in section 4.5.
2. The helicopter will be fitted with the Quick Release Bicycle Rack Installation in accordance with drawing 100202 for the configurations specified in section 4.5.

3. The helicopter will be fitted with the Quick Release Cabin Step Installation in accordance with drawing 101001 on the side opposite to the Quick Release Bicycle Rack Installation for the configurations specified in section 4.5..
4. The helicopter will be fitted with vibration analysis equipment installed in accordance with Maintenance Manual Chapter 05-50-00, section 6-21, *Diagnosis of defects by vibration analysis*, with accelerometers/velocimeters located in the cockpit, main rotor and tail rotor as specified. Additional accelerometers/velocimeters may be installed in accordance with the Maintenance Manual for reference information.

4.3 Flight Test Crew

Two crew members will be required for the test:

1) Pilot with training and experience appropriate to the task of testing this equipment.
2) Test observer, either a DAR or a qualified alternate, beside the pilot.

All members of the crew will be equipped to communicate via intercom.

Seating arrangement of the observer(s) may be limited by loading requirements.

4.4 Documents

Attach copies of the following documents to the completed report.

- Flight Authority, Flight Test Permit issued by Transport Canada. Flight permit must allow flight to 1.11 Vne.
- Current Weight and Balance report showing test configurations.
- Conformity Inspection Record AN B043, signed by qualified AME.
- Statement of Suitability for Flight Test, SI 521-004, Table F-1
- Flight Test Safety Check List, SI 521-004, Table F-2
- Confirmation of insurance with aircraft in test configuration
- The draft Flight Manual Supplement, FMS1009.91 Revision 0, shall be on board the aircraft.

The Pilot will familiarize himself with the contents of this Test Plan and the Flight Manual Supplement prior to flight.

4.5 Configuration

The helicopter will be loaded with sufficient fuel and ballast to produce the following conditions for flight:

A) Helicopter un-modified*, with weight and balance within limits specified in the flight manual

B) Bicycle Rack configuration 100202-01-02 installed on the right hand side, no bikes; Cabin Step configuration 101001-01-01 installed on the left hand side

C) Bicycle Rack configuration 100202-01-02 installed on the right hand side, 3 bikes loaded; Cabin Step configuration 101001-01-01 installed on the left hand side

D) Bicycle Rack configuration 100202-01-01 installed on the left hand side, no bikes; Cabin Step configuration 101001-01-02 installed on the rightt hand side

E) Bicycle Rack configuration 100202-01-01 installed on the left hand side, 3 bikes loaded; Cabin Step configuration 101001-01-02 installed on the right hand side

F) Bicycle Rack configuration 100202-01-01 and 100202-01-02 installed on both sides, both racks loaded with 3 bikes each.

*Note: The External Attachment Fittings Installation (100903) may be installed without the Quick Release Mounting Beams Installation (100902) for the unmodified flight.

C of G must remain within the limits specified in the Flight Manual. Similar longitudinal C of G and weight to be maintained for each flight.

Loading information specific to the Quick Release Bicycle Rack is contained in the Flight Manual Supplement, FMS1002.91. The bike racks will be loaded with mountain/downhill type bikes, 26"-29" wheels, which fit and can be properly secured by the bike rack locking frame.

5.0 FLIGHT TESTS

5.1 Vibration and Handling Flights

One flight is required for each of the configurations listed in 4.5 above.

The flights are to be conducted as follows:

Take off and establish cruise at 50 kts. Increase speed in 10 kt increments up to Vne. Recover from Vne, then accelerate to Vd (1.11 x Vne).

Vne as follows, refer to the Flight Manual:

Airbus Helicopters EC130 B4

Configuration A, B, D – unmodified or no bikes mounted on rack

Vne = 155 KIAS at sea level, reduce by 3 knots per 1000 feet.

Vd = 1.11 x Vne = 172 KIAS at sea level, reduce with altitude per Vne reduction

Configuration C, E, F – bikes mounted on the bike rack

Vne = 110 KIAS

Vd = 1.11 x Vne = 122 KIAS

If maximum Vne/Vd shown above is not achieved, record maximum speed. Note limiting condition(s) in observations.

Record that each airspeed shows acceptable vibration and handling qualities by putting a check in each box in section 6.0. Record any observations. Record/include the vibration analysis output.

5.2 Other Flights

Flight testing performed by a Transport Canada Flight Test Division Pilot may deviate from this test plan at the discretion of the test pilot in order to complete a Transport Canada prepared flight test report.

6.0 RECORDING OF RESULTS

Model: Airbus Helicopters EC130 B4

Serial Number: ________________

Registration: ______C-GUNL______

Gross Weight: __________lb______

Results:

EC130 B4	Airspeed (KIAS)											
Configuration	50	60	70	80	90	100	110	120	130	140	Vne (155)	Vd (172)
A) Un-modified												
B) 100201-01-02 Bike Rack (RH) Empty												
C)100202-01-02 Bike Rack (RH) 3 Bikes									X	X	X	X
D) 100201-01-01 Bike Rack (LH) Empty												
E)100202-01-01 Bike Rack (LH) 3 Bikes									X	X	X	X
F) 100202-01-01 100202-01-02 Both Bike Racks 3 Bikes each									X	X	X	X

Observations:

____

____

Flight test performed by: Date:

____

TEST PLAN AND REPORT

TR1002.06

AIRBUS HELICOPTERS EC130 B4

QUICK RELEASE BICYCLE RACK INSTALLATION

LOAD TESTS

Reviewed by Jason
15/07/2015

Prepared by: Jeff Clarke, P.Tech.(Eng.)

Revision 0, 14 July 2015

Aero Design Ltd.

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www.aerodesign.ca

TABLE OF CONTENTS

1.0 INTRODUCTION

This report documents the load tests used to demonstrate compliance with the structural requirements of the basis of certification.

2.0 REFERENCE TEXT

Engineering Report ER1002.05, Revision 0, Quick Release Bicycle Rack Installation – Compliance report

-Loads, section 4.0

Aero Design Ltd. Installation Drawings:
100202, Revision 0 – Bicycle Rack Installation
100902, Revision 0 – Quick Release Mounting Beams Installation
100903, Revision 0 – External Attachment Provisions Installation

Aero Design Ltd. Fabrication Drawings:
100211, Revision 0 – Bike Rack Assembly
100215, Revision 0 – Forward Frame Assembly
100220, Revision 0 – Forward Frame Fabrication
100221, Revision 0 – Aft Frame Fabrication
100222, Revision 0 – Bushing Fabrication
100223, Revision 0 – Strap Fabrication
100230, Revision 0 – Beam Fabrication
100231, Revision 0 – Forward Bracket Fabrication
100235, Revision 0 – Attachment Bracket Fabrication

3.0 LOADS

The loads are determined in Engineering Report ER1002.05, Revision 0. The summarized loads are below.

3.1 Combined Positive Maneuvering and Drag Load

Limit loads

$P_{man\_lim\_rack}$ = 227 lbs — Limit positive maneuvering load due to rack

$P_{man\_lim\_bike1}$ = 140 lbs — Limit positive maneuvering load due to bikes (inboard and centre positions, 40 lb bike)

$P_{man\_lim\_bike3}$ = 175 lbs — Limit positive maneuvering load due to bike (outboard position, 50 lb bike)

$P_{man\_lim\_test}$ = 227 lbs + 140 lbs + 140 lbs + 175 lbs - 65 lbs
(rack applies 1g down – 65 lbs)

$P_{man\_lim\_test}$ = 617 lbs — Limit positive maneuvering load required for test

$P_{drag\_lim\_bike}$ = 70 lbs — Limit drag load on each bike

P_{drag_lim} = 346 lbs — Limit drag load on bikes and rack

Ultimate loads

$P_{man\_ult\_rack}$ = 341 lbs — Ultimate positive maneuvering load due to rack

$P_{man\_ult\_bike1}$ = 210 lbs — Ultimate positive maneuvering load due to bikes (inboard and centre positions, 40 lb bike)

$P_{man\_ult\_bike3}$ = 263 lbs — Ultimate positive maneuvering load due to bike (outboard position, 50 lb bike)

$P_{man\_ult\_test}$ = 341 lbs + 210 lbs + 210 lbs + 263 lbs - 65 lbs
(rack applies 1g down – 65 lbs)

$P_{man\_ult\_test}$ = 959 lbs — Ultimate positive maneuvering load required for test

$P_{drag\_ultbike}$ = 104 lbs — Ultimate drag load on each bike

P_{drag_ult} = 520 lbs — Ultimate drag load

3.2 Negative Maneuvering Load

Ultimate loads

$P_{man\_neg\_ult\_bike}$ = 75 lbs — Ultimate negative maneuvering load due to bike (50 lb bike)

$P_{man\_neg\_ult\_bike\_test}$ = 75 lbs – 30 lbs (test bike weight approx. 30 lbs)
$P_{man\_neg\_ult\_bike\_test}$ = 45 lbs — Ultimate negative maneuvering load applied to bike in test

3.3 Sideward Load

Ultimate loads

P_{e_side} = 100 lbs — Ultimate side load due to bike (50 lb bike)

$P_{e\_side\_test}$ = 100 lbs – 30 lbs (test bike weight approx. 30 lbs)
P_{e_side} = 70 lbs — Ultimate side load applied to bike in test

4.0 TEST SETUP

4.1 Test Articles

The tests will be performed using the following parts fabricated and assembled in accordance with their respective drawings:

100211-01 – LH Bike Rack Assembly
100915-01 – Forward Beam Assembly
100916-01 – Aft Beam Assembly
100930-01 – Forward Fitting
100931-01 – Aft Fitting

Form AN B043 conformity inspection record will be completed by Aero Design Ltd. The test articles will be available for inspection by Transport Canada.

Bicycles – (Model, with 26" x ?? tires)
(model, with 29" x ?? tires)

4.2 Test Fixture

The tests are performed on a fixture that simulates the hardpoints on the helicopter, the forward landing gear attachments and aft fuel cell cross member.

The fixture consists of two large rectangular steel tubes (4" x 6" x 3/8" wall), each welded to a base plate (1/2"), with channels (C5x6.7) welded to the sides to provide mounting points for further fixtures specific to the aircraft to be simulated. Tabs (1/4" plate) are welded to the top of the tubes to install bracing as required to maintain rigidity. The fixtures are bolted down to inserts in the concrete floor.

Figure 4.2.1 – Test Fixture – Looking aft at forward fixture

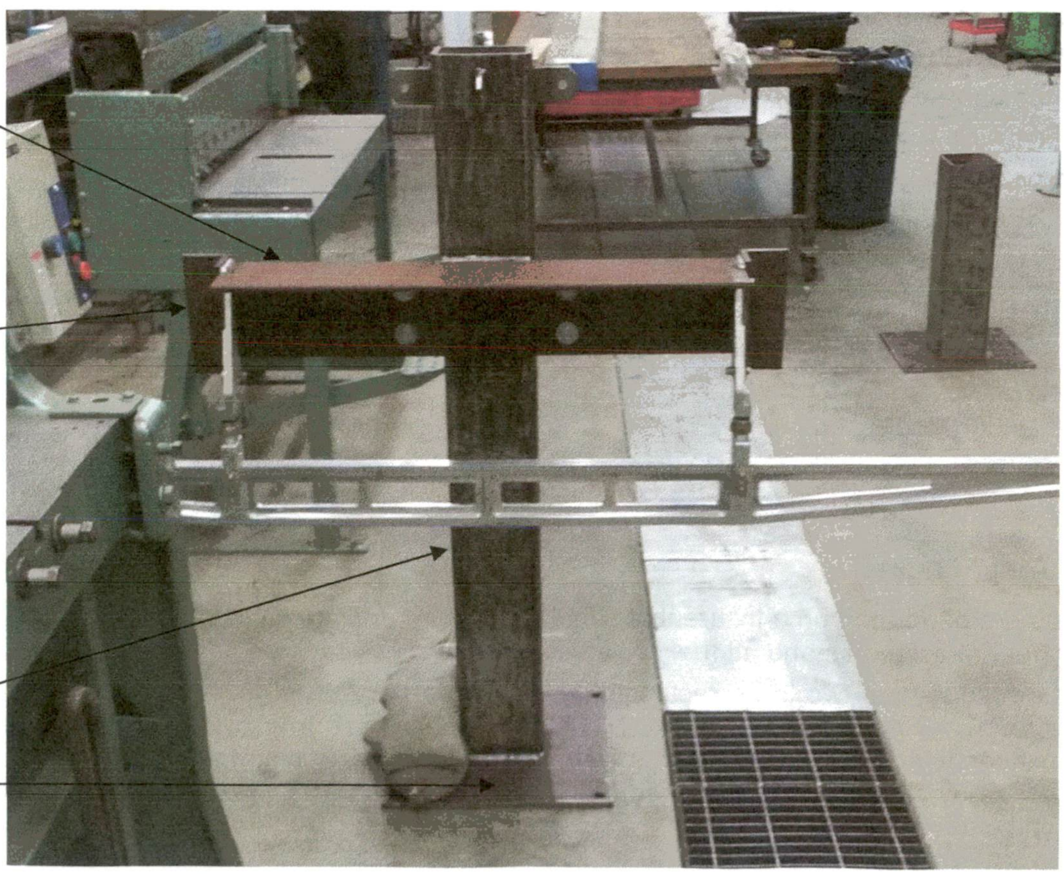
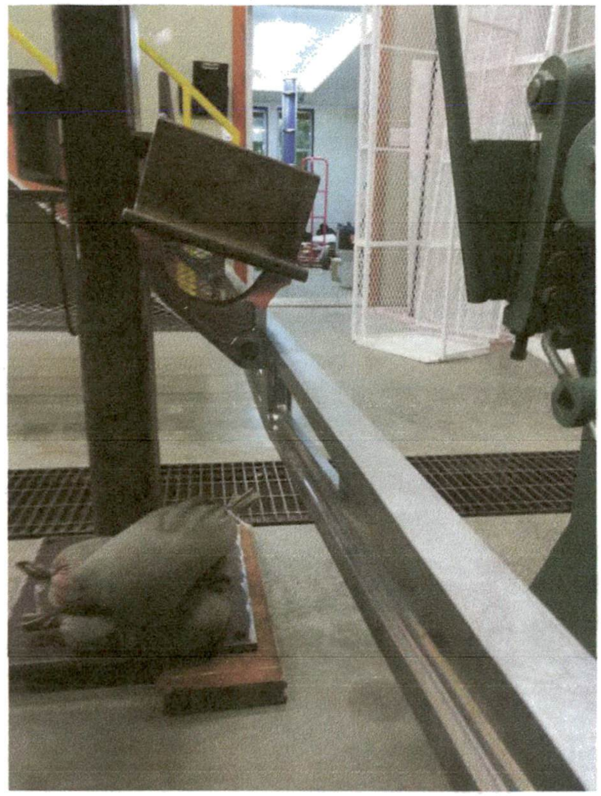


Figure 4.2.2 – Test Fixture – Looking aft at aft fixture

For this configuration, large steel angles (6" x 6" x 3/8") are used to locate smaller angles on the ends (4" x 4" x ½" forward; 3" x 3" x 3/8" aft) that simulate the airframe attachment points. The large angles are bolted to the channels on the tubes mentioned above with four ½" bolts.

The external attachment fittings are installed on the fixture in accordance with drawing 100903. The quick release mounting beams are installed on the external attachment fittings in accordance with drawing 100902. The bike rack is installed on the quick release mounting beams in accordance with drawing 100202.

Aft



Forward

Figure 4.2.3 – External Attachment Fittings and Quick Release Mounting Beams

Figure 4.2.4 – Test Setup – Looking down and aft

Figure 4.2.5 – Test Setup – Looking forward

Figure 4.2.6 – Test Setup – Looking aft

For the individual bike tests, (drag, negative maneuvering and side conditions), the bike rack does not need to be installed on the mounting provisions. It may be clamped or otherwise secured in the orientation as needed in order to load the bike only.

To simulate the combined drag on the rack, the centre rail may be pulled at the aft frame attachment bolts, back to a post secured to the floor.

4.3 Procedure

4.3.1 Individual Bike - Drag Load

1. Set bike rack on floor with bottom suitably protected and leveled with 2x4's. Insert bike onto rack with handlebars aft and secure the bike by moving the forward frame into contact with tire and locking the cam lever.
2. Secure forward end of bike rack to drag post using a strap.
3. Pull drag load on bike frame using a strap. Seat the strap in the frame intersection with the head set tube.
4. Pull the ultimate drag load (104 lbs) aft on bike using a spring scale.
5. The load must be applied for at least 3 seconds.
6. Document the test with pictures of the load application and of the overall test.
7. With the load applied, CAREFULLY attempt to shift the bike in frame. Ensure the bike cannot be pulled free of the frame.
8. CAREFULLY release the drag load.
9. Inspect the bike on the frame. Ensure that applying and releasing the drag load has not loosened the bike in the frame.
10. Remove the bike from the rack.
11. Visually inspect the bike rack for signs of permanent deformation.
12. Record the results in section 5.1 below.

4.3.2 Individual Bike - Negative Maneuvering Load

1. Insert bike onto rack and secure the bike by moving the forward frame into contact with tire and lock the cam lever. Hang bike rack upside down between tables, suitably blocked, protected and leveled with 2x4's.
2. Set 2 bags of lead shot (50 lbs) on outermost frame tube and/or seat tube.
3. The load must be applied for at least 3 seconds.
4. Document the test with pictures of the load application and of the overall test.
5. With the load applied, CAREFULLY attempt to shift the bike in frame. Ensure the bike cannot be pulled free of the frame, including by rotating the handlebars.
6. CAREFULLY remove the bags of shot.
7. Set bike rack up right. Inspect the bike on the frame. Ensure that applying and releasing the negative maneuvering load has not loosened the bike in the frame.
8. Remove the bike from the rack.
9. Visually inspect the bike rack for signs of permanent deformation.
10. Record the results in section 5.2 below.

4.3.3 Individual Bike - Side Load

1. Clamp bike rack on its side to a table, suitably blocked, protected and leveled with 2x4's. Insert bike onto rack and secure the bike by moving the forward frame into contact with tire and locking the cam lever.
2. Set 3 bags of lead shot (75 lbs) on outermost frame tube and/or seat tube.
3. The load must be applied for at least 3 seconds.

4. Document the test with pictures of the load application and of the overall test.
5. With the load applied, CAREFULLY attempt to shift the bike in frame. Ensure the bike cannot be pulled free of the frame, including by rotating the handlebars.
6. CAREFULLY remove the bags of shot.
7. Inspect the bike on the frame. Ensure that applying and releasing the side load has not loosened the bike in the frame.
8. Remove the bike from the rack.
9. Visually inspect the bike rack for signs of permanent deformation.
10. Record the results in section 5.3 below.

4.3.4 Combined Positive Maneuvering and Drag Load

1. Install the bike rack on the mounting beams.
2. Apply the limit maneuvering load (617 lbs) downward using bags of lead shot, 25 lbs each, distributed over the bottom of the rack, centered on the aft attachment frame. 25 bags are required (625 lbs total).
3. Pull limit drag load (346 lbs) aft on center rack using a load cell and chain come-along.
4. The load must be applied for at least 3 seconds.
5. Document the test with pictures of the bags of lead shot stacked on the rack and of the overall test.
6. CAREFULLY release the drag load.
7. CAREFULLY remove the bags of lead shot. Keep feet clear of rack.
8. Visually inspect the bike rack, mounting beams and attachment fittings for signs of permanent deformation.
9. Apply the ultimate maneuvering load (959 lbs) downward using bags of lead shot, 25 lbs each, distributed over the bottom of the rack, centered on the aft attachment frame. 39 bags are required (975 lbs total).

   CAUTION: KEEP FEET CLEAR FROM UNDER BIKE RACK.
10. Pull ultimate drag load (520 lbs) aft on center rack using a load cell and chain come-along.
11. The load must be applied for at least 3 seconds.
12. Document the test with pictures of the bags of lead shot stacked on the rack and of the overall test.
13. CAREFULLY release the drag load.
14. CAREFULLY remove the load from the rack. Keep feet clear of rack. Remove the bike rack from the mounting beams.
15. Visually inspect the bike rack, mounting beams and attachment fittings for signs of permanent deformation or failure.
16. Record the results in section 5.4 below.

4.3.5 Contaminated Mechanism Pull Test

1. Set bike rack on floor with bottom suitably protected and leveled with 2x4's. Apply contaminant to rollers and bike rack, see table in section 5.5. Secure the forward frame by locking the cam lever in the contaminant.
2. Secure aft end of bike rack to drag post using a strap.

3. Pull on movable frame using strap fixture and a spring scale to measure break out force required to cause frame to slide.

4. Repeat test at least 3 times.
5. Record the results in section 5.5 below.
6. Clean the applied contaminant and repeat test for each contaminant in table 5.5.

5.0 TEST RESULTS

5.1 Individual Bike Drag Load

Tests witnessed by TCCA DAR 304 James Tinson on XX.

5.1.1 Ultimate Load

Condition	Required Load	Actual Load	Witness Initial
Ultimate Drag (aft) 26" tires	104 lbs (pulled on bike)	lbs	
Ultimate Drag (aft) 29" tires	104 lbs (pulled on bike)	lbs	

(The rack sustained the ultimate drag load applied to the bike. During the test the bike was checked to ensure it would not pull free of the frame. After completing the ultimate load test, the bike was checked to ensure it had not come loose in the frame. The rack was inspected for signs of permanent deformation. There was none found.)

5.2 Individual Bike Negative Maneuvering Load

Tests witnessed by TCCA DAR 304 James Tinson on XX.

5.2.1 Ultimate Load

Condition	Required Load	Actual Load	Witness Initial
Ultimate Negative Maneuvering Load (up) 26" tires	75 lbs (45 lb test) (pulled on bike)	50 lbs	
Ultimate Negative Maneuvering Load (up) 29" tires	75 lbs (45 lb test) (pulled on bike)	50 lbs	

(The rack sustained the ultimate negative maneuvering load applied to the bike. During the test the bike was checked to ensure it would not pull free of the frame. After completing the ultimate load test, the bike was checked to ensure it had not come loose in the frame. The rack was inspected for signs of permanent deformation. There was none found.)

5.3 Individual Bike Side Load

Tests witnessed by TCCA DAR 304 James Tinson on XX.

5.3.1 Ultimate Load

Condition	Required Load	Actual Load	Witness Initial
Side Load 26" tires	100 lbs (75 lbs test) (pulled on bike)	lbs	
Side Load 29" tires	100 lbs (75 lbs test) (pulled on bike)	lbs	

(The rack sustained the ultimate sideward load applied to the bike. During the test the bike was checked to ensure it would not pull free of the frame. After completing the ultimate load test, the bike was checked to ensure it had not come loose in the frame. The rack was inspected for signs of permanent deformation. There was none found.)

5.4 Positive Maneuvering Load

Tests witnessed by TCCA DAR 304 James Tinson on XX.

5.4.1 Limit Load

Condition	Required Load	Actual Load	Witness Initial
Limit Maneuvering Load (downward)	682 lbs (617 test) (distributed over rack)	lbs	
Limit Drag (aft)	346 lbs (pulled on rack)	lbs	

(The bike rack and mounts supported the limit positive maneuvering and drag loads for more than 3 seconds. After completing the limit load test, the bike rack was inspected for permanent or detrimental deformation. There was none found.)

(picture)

Figure 5.1.3 – Limit Cargo Load

(picture)

Figure 5.1.4 – Limit Cargo Load

5.4.2 Ultimate Load

Condition	Required Load	Actual Load	Witness Initial
Ultimate Maneuvering Load (downward)	1024 lbs (959 test) (distributed over rack)	lbs	
Ultimate Drag (aft)	520 lbs (pulled on rack)	lbs	

(The bike rack and mounts supported the ultimate positive maneuvering and drag loads for more than 3 seconds. After completing the ultimate load test, the bike rack and mounts were inspected for permanent or detrimental deformation and failure. There was none found.)

(picture)

Figure 5.1.3 – Ultimate Cargo Load

(picture)

Figure 5.1.4 – Ultimate Cargo Load

5.5 Contaminated Mechanism Pull Test

Tests witnessed by TCCA DAR 304 James Tinson on XX.

5.5.1 Ultimate Load

Condition	Breakout Loads	Witness Initial
Bare (powder coat), no contaminants		
WD-40		
Mobil Grease 28		
Talcum Powder		
Abrasive Grit (sand / glass)		

CERTIFICATION PLAN

CP1009

AIRBUS HELICOPTERS EC130 B4

EXTERNAL MOUNTING PROVISIONS INSTALLATION
QUICK RELEASE CARGO BASKET INSTALLATION
QUICK RELEASE CABIN STEP INSTALLATION

Reviewed by Jason 13 July 2015

Prepared by: Jeff Clarke, P.Tech.(Eng.)

Revision 1, 29 June 2015

Aero Design Ltd.

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TABLE OF CONTENTS

4.0 PROJECT DESCRIPTION

4.1 General

Aero Design Ltd. produces cargo baskets and cabin steps for many helicopter models. All Aero Design baskets use similar mounting provisions which incorporate the same quick release system. This new configuration for the Airbus Helicopters EC130 draws elements from a number of other models: the fuselage attachments are similar to the Bell 206B configuration; the mounting beams are similar to those used on the Bell 206L/407; the basket is identical to the AS350 extra large basket using the mounting points at the end of the basket from the AS350 short basket configuration; and the cabin step is similar to the maintenance steps for the AS350.

4.2 Fixed Mounting Provisions

The fixed mounting provisions consist of the fuselage attachment points and the mounting beams which incorporate the quick release mechanism.

The original Airbus Helicopters billet machined 7175 Aluminum Forward Cross Tube Clamps are replaced with Aero Design billet machined 7075-T651 Aluminum Clamps. These replacement clamps include integral lugs to accommodate barrel nuts in order to provide hard points for the attachment of the Forward Beam. These hard point provisions are identical to the Aero Design hard point provisions for the Bell 206L/407 Cargo Baskets. See ER1009.01 for the applicable fatigue/ strength /dimensional /protection /hardware /service qualification analysis for these replacement clamps.

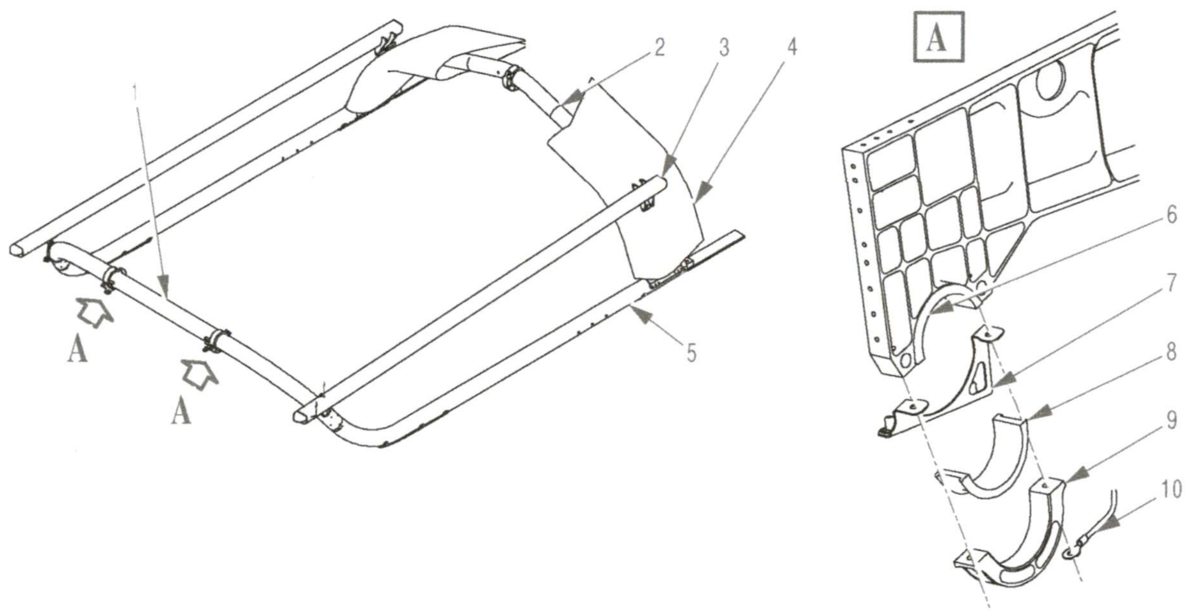

Figure 4.2.1 – Original Landing Gear Attachments

1.0 INTRODUCTION

This certification plan details the means and methods of compliance for the Airworthiness Requirements shown on the Compliance Program Checklist (Appendix A).

This reissue of STC SH08-16 adds the Airbus Helicopters EC130B4 configurations to the existing Airbus Helicopters AS350/AS355 configurations as both models share the same type certificate data sheet and the installations use many of the same components.

2.0 DEFINITIONS

The following abbreviations are used in this document:

FMS – Flight Manual Supplement

ICA – Instructions for Continued Airworthiness

3.0 PERSONNEL

Applicant: Aero Design Ltd. – Jeff Clarke, P.Tech.(Eng.)

Delegate: DAR304 James Tinson, P.Eng.

Transport Canada: Jack Staal, PNR Region

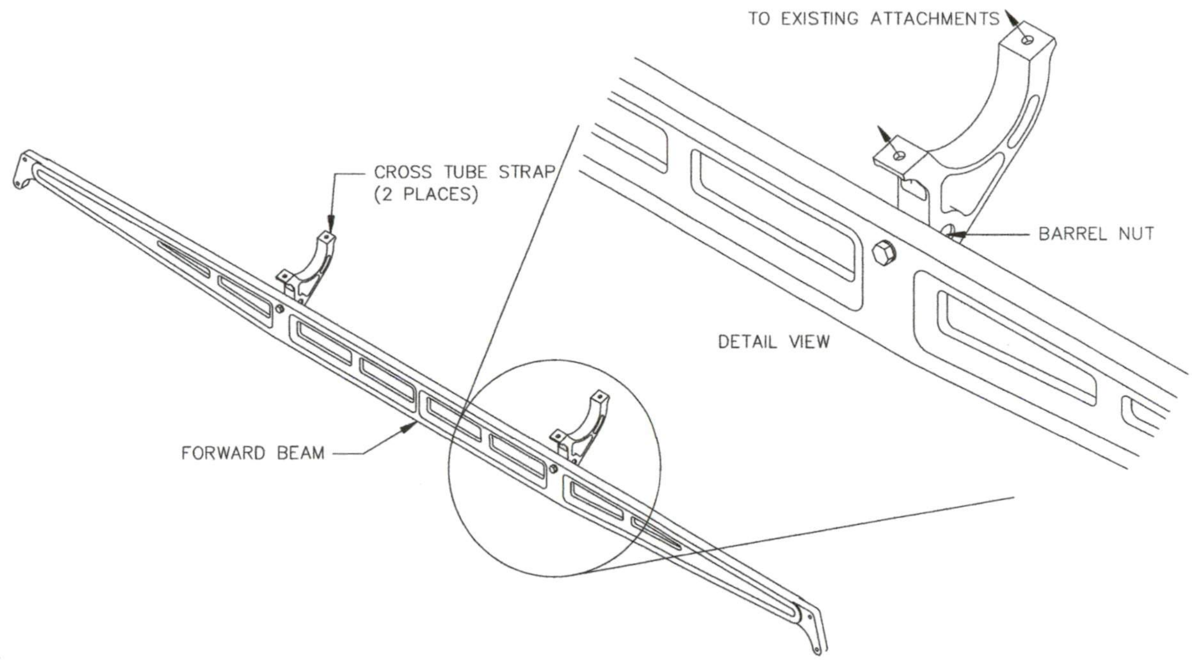

Figure 4.2.2 – Forward Attachment Provisions

The aft attachment picks up on the main fuselage frames at the aft fuel cell cross member (figure 4.2.3, "A"). The aft fuel cell cross member includes the aft attachment points for the cargo swing (2557 lbs slung load), which is used to calculate the allowable loads on the frame per Engineering Report ER1009.01. In order to install the lower aft fuselage fairing panel, which slides between the fuselage frames and landing gear fairings with little room to rotate, the aft attachment fittings cannot extend lower than the fairing panel once installed. To simplify installation and reduce the required cutout size in the fairing panel, the fitting incorporates a 5000 lb seat stud fitting, the same as the basket attachments. The mounting beam attaches to the fitting with a 5000 lb seat stud quick disconnect claw fitting (see figure 4.2.4). The claw fitting is secured via an integral locking ring feature, as well as an external ring to prevent inadvertent release.

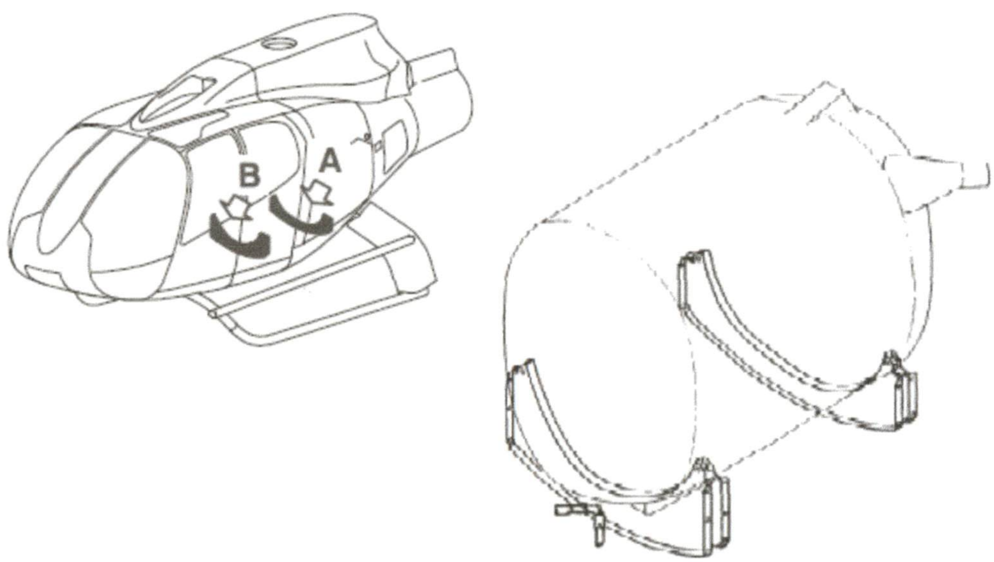

Figure 4.2.3 – Fuel Cell Support Members

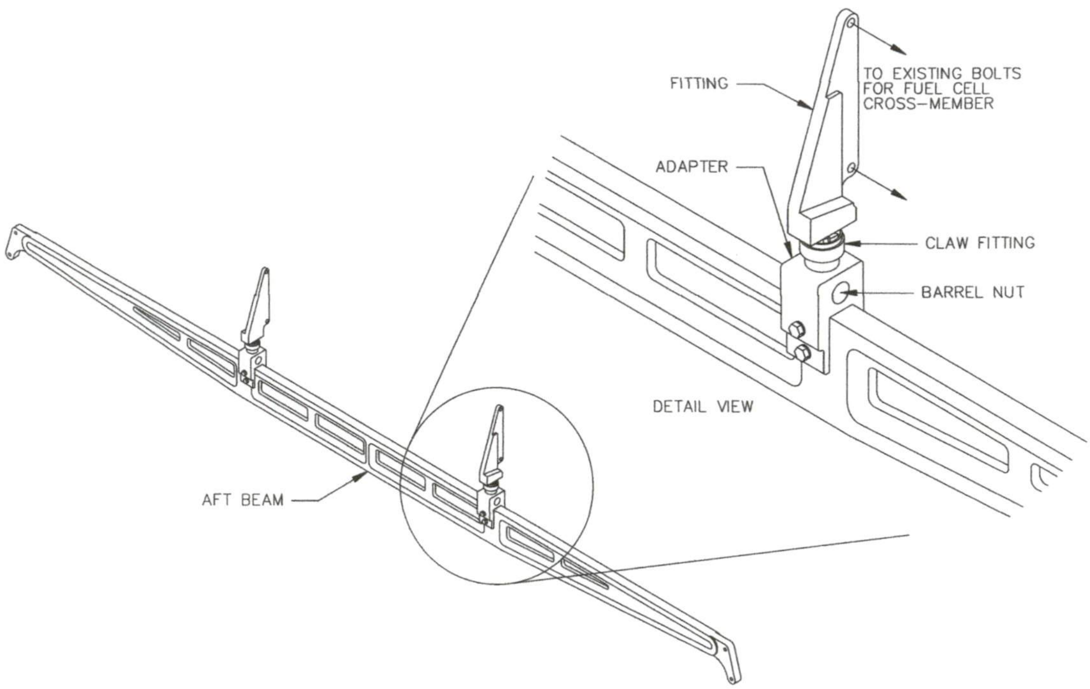

Figure 4.2.4 – Aft Attachment Provisions

The forward and aft mounting beams are machined 7075-T651 aluminum bars, spanning the width of the fuselage, approximately 85 inches (2.2 m) wide. The beams are pocketed with through holes to reduce weight and allow airflow through the beam.

Stainless steel down tubes, with keyways in the outboard faces for attaching the basket or other equipment, are attached to the outboard ends of the aluminum beams. The down tubes are virtually identical to all other Aero Design mounting beams. The arrangement of horizontal and vertical keyways allows the use of a single pin to retain the basket, step or bike rack, simplifying installation and removal.

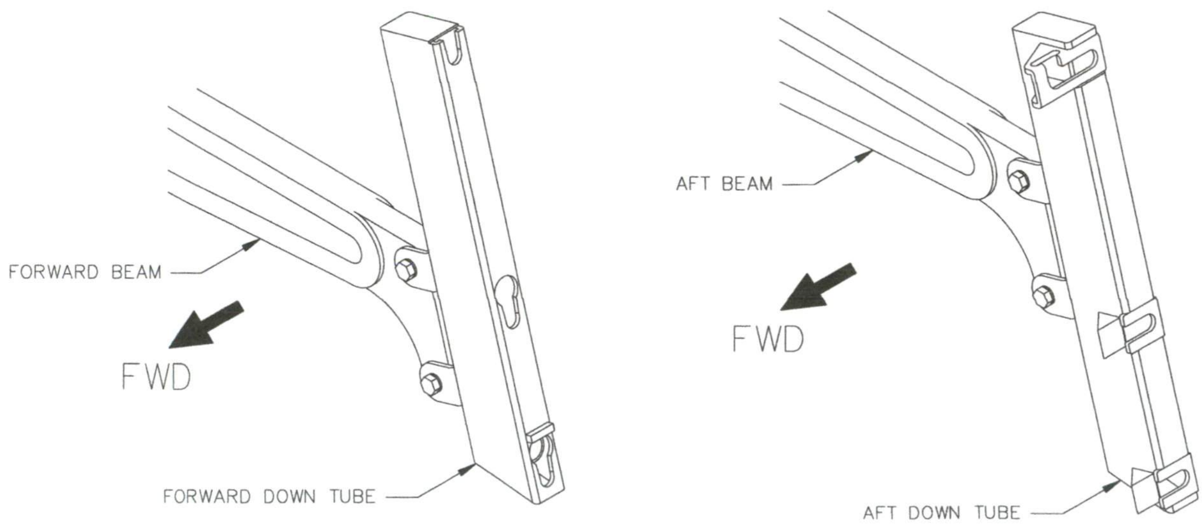

Figure 4.2.5 – Down Tubes

4.3 Quick Release Cargo Basket

The only difference between the existing AS350 extra large basket (model 940) and the EC130 extra large basket (model 1009) is the attachment points are moved to the first and last hoops, which is the same configuration as the AS350 medium and short baskets (model 764 and 776). All other construction of the basket remains the same as basket model 940. The 300 lb (136 kg) cargo load limit also remains the same.

The basket and lid are fabricated from a welded 4130 steel tubing structure (3/4" rims, ½" hoops and spines), and lined with expanded steel mesh. The basket attachments are located on the most forward and aft hoops of the basket. The end hoops include a brace strut tube to support the outboard edge of the basket back to the attachment points. The lid is attached with extruded hinge, riveted to the structure. The lid is secured closed with the handle, which is locked into brackets on the basket body, with an additional safety catch included that will retain the lid in the event the handle is not correctly latched. The lid is held open with a sliding brace that automatically locks in the open position and must be manually unlatched to close the lid.

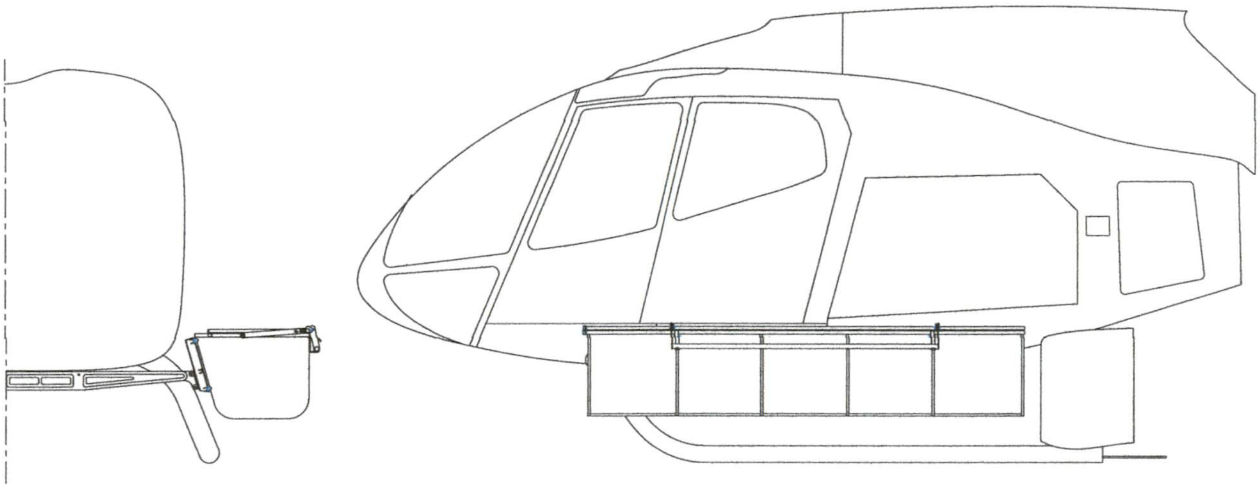

Figure 4.3.1 – Model 1009Quick Release Cargo Basket

4.4 Quick Release Cabin Step

Installation of the Mounting Provisions requires removal of the existing cabin step provided as part of the type approved configuration. On the side opposite to the cargo basket or equipment installation, or when the basket or equipment is removed, a step to access the cabin is required.

The Quick Release Cabin Step is installed on the helicopter using the Mounting Provisions supplied for use with the Quick Release Cargo Basket. The step is an aluminum extrusion, with aluminum brackets welded to the ends with fittings that engage in the mounting beams. The step locks into the same mechanism on the mounting beams as the basket.

The step is similar to the cabin step used for the Bell 429, however the length is increased from 74.75" to 96".

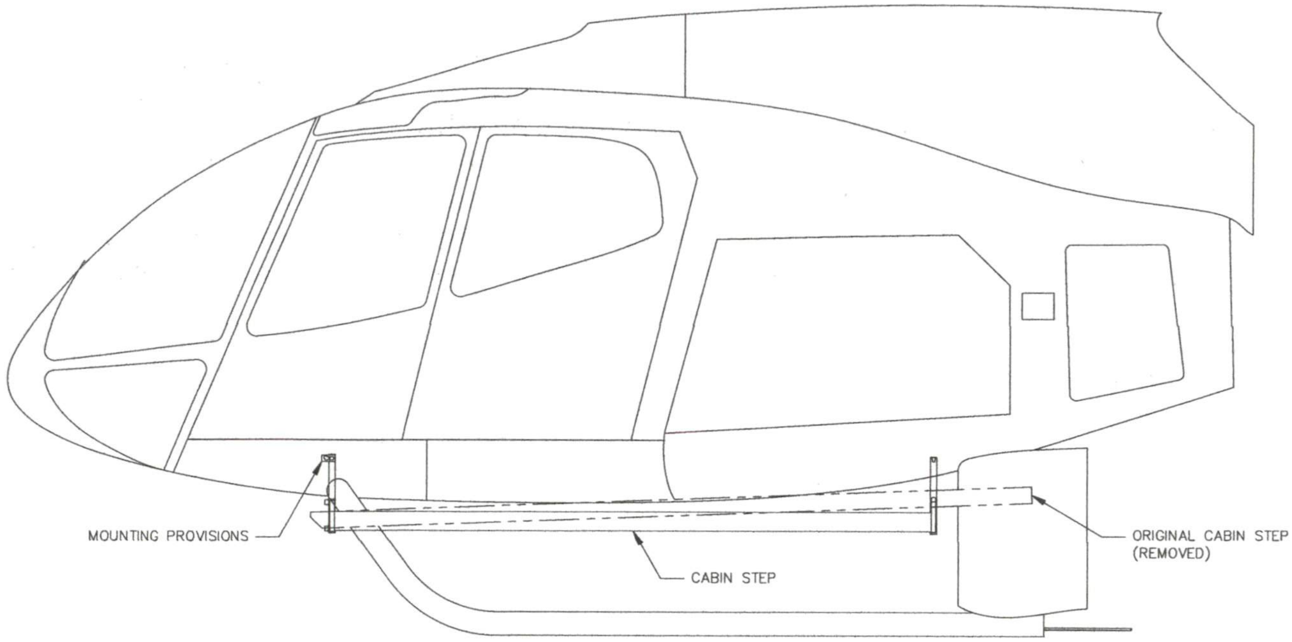

Figure 4.4.1 – Model 1010 Quick Release Cabin Step

4.5 Comparison of Configurations

The following information is preliminary in nature and subject to change.

Configuration	Max Cargo	Installed Weight	Length (outside)	Width (outside)	Depth (outside)	Frontal Area	Long. C of G	Lateral C of G
Provisions 100902-01	N/A	41 lbs	N/A	N/A	N/A	256 in^2	102.2 in	0.0 in
Basket, LH 100901-01-01	300 lbs	75 lbs	97.0 in	25.5 in	20.2 in	458 in^2	100.9 in	-56.9 in
Basket, RH 100901-01-02	300 lbs	75 lbs	97.0 in	25.5 in	20.2 in	458 in^2	100.9 in	56.9 in
Cabin Step, LH 1010-01-01	N/A	9 lbs	104.8 in	4.7 in	4.8 in	11.6 in^2	100.9 in	-47.0 in
Cabin Step, RH 1010-01-02	N/A	9 lbs	104.8 in	4.7 in	4.8 in	11.6 in^2	100.9 in	47.0 in

5.0 BASIS OF CERTIFICATION

Model: Airbus Helicopters EC130 B4

TCDS:

- TCCA: H-83 Issue 22
- FAA: H9EU Revision 23
- EASA: R.008 Issue 8

Note: This installation may not be applicable to the EC130 T2 due to differences in the aft fuel cell support structure related to the crashworthy fuel cell.

5.1 TCCA Basis of Certification

5.1.1 TCCA – TCDS H-83, Issue 22

The following Certification Basis has been accepted as equivalent to the Airworthiness Manual Chapter 527 at Change 3 dated January 3, 1994:

a) JAR 27 First Issue dated September 6, 1993 with orange paper amendment 27/98/1 effective February 16, 1998.

b) JAA Special Condition on High Intensity Radiated Field.

c) Exemption for Rear Bench Seat regarding JAR 27-562 and JAR 27-785(a),(b),(j) and for Fuel Systems regarding JAR 27952(a),(c),(d),(f),(g).

d) Equivalent Safety Findings on Main Gearbox Oil Filter By Pass and Powerplant Instrument Markings.

e) Provisions of ICAO Annex 16, Volume I, Third Edition, Amendment 5, Chapter 8.

f) Fuel Discharge as per ICAO Second Edition dated July 1993 Annex 16, Volume 2, 2nd Part.

g) In addition the following Transport Canada Additional Airworthiness Requirements as published in the Canadian Airworthiness Manual, Chapter 527, Change 3 dated January 3, 1994:

   i) 527.1093 (b)(l) Engine Operation in Snow

   ii) 527.1301-1 Rotorcraft Operations After Ground Cold Soak

   iii) 527.1557(c)(3) Miscellaneous Markings and Placards

   iv) 527.1581(e),(f) Rotorcraft Flight Manual

   v) 527.1583(h) Operating Limitations, Ambient Temperature

AWM 516, *Aircraft Emissions*: Subchapter A for Aircraft Noise (this refers to International Civil Aviation Organization (ICAO) Annex 16, Volume I) and Subchapter B for Prevention of Vented Fuel (this refers to ICAO Annex 16, Volume II, Part 11).

Arriel2B1 engine -Third Edition/Arndt 5, Chapter 8

5.2 Equivalency of Canadian Basis of Certification to Foreign Basis

This section addresses the basis of certification in foreign jurisdictions for which this approval may be familiarized following issue of the Canadian approval.

5.2.1 FAA – TCDS H9EU, Revision 23

14 CFR 21.29 and part 27 Amendment 27-1 through Amendment 27-32, except 14 CFR 27.952 is not adopted.

14 CFR 36 Appendix H through Amendment 20.

Special Condition 27-009-SC for HIRF.

Equivalent Level of Safety Findings

- 14 CFR 27.1549(b) Powerplant Instrument Markings

- 14 CFR 27.1027(b)(2) Main Gearbox Oil Filter Bypass

The Canadian basis of certification defined on TCDS H-83 is equivalent to the FAA basis of certification defined on TCDS H9EU.

5.2.2 EASA – TCDS R.008, Issue 8

JAR 27 first issue dated September 6, 1993, and orange paper amendment 27/98/1 effective February 16, 1998.

Exemption for Rear Bench Seat regarding JAR 27-562 and JAR 27-785(a),(b),(j) and for Fuel Systems regarding JAR 27952(a),(c),(d),(f),(g).

Equivalent Safety Findings on Main Gearbox Oil Filter By Pass and Powerplant Instrument Markings.

The Canadian basis of certification defined on TCDS H-83 is equivalent to the EASA basis of certification defined on TCDS R.008, as stated on TCDS H-83.

5.3 This Modification

The basis of certification for this modification has been considered in accordance with CAR 521.158 - Standards of Airworthiness, SI 521-004 and SI 521-005, and AC 500-16. The Changed Product Rule Decision Record, CPR-DR1009, Rev. 0 (Appendix B), documents the following findings with regards to this modification:

- this modification is not substantial
- the latest standards will not be used
- this change is not significant
- the basis of certification for this modification remains the same as the original basis of certification for the aircraft as defined in the TCDS.

The FAA basis of certification is more clearly written and has better control over previous revisions to the FARs, therefore it is proposed to use the FAA basis of certification for this project.

The Canadian Additional Airworthiness Requirements, as applicable, are addressed as shown below:

a) 527.1093 (b)(l) Engine Operation in Snow

b) 527.1301-1 Rotorcraft Operations After Ground Cold Soak
c) 527.1557(c)(3) Miscellaneous Markings and Placards
d) 527.1581(f) Rotorcraft Flight Manual
e) 527.1583(h) Operating Limitations, Ambient Temperature
f) 527.1581(f) Rotorcraft Flight Manual

This installation introduces no changes from Type Approved configuration for the above paragraphs.

g) 527.1581(e) Rotorcraft Flight Manual

This installation includes metric units as required by 527.1581(e).

(Note this paragraph has been removed from the standards at Change 527-4.)

Please indicate agreement that the basis of certification for this project shall be to the FARs as defined on the FAA TCDS H9EU as applicable by signing below, or providing said agreement via email.

For Transport Canada Civil Aviation Date

6.0 APPLICABILITY OF AIRWORTHINESS DIRECTIVES

Airworthiness Directives applicable to the Airbus Helicopters EC130 B4 were reviewed on 29 April 2015, and none were found to be affected by this project.

7.0 CERTIFICATION PLAN

The certification plan and compliance checklist (Appendix A) use the FAR paragraphs as they have been determined to be equivalent to the Canadian basis of certification, refer to section 5.3.

7.1 General

Re-issue of the approval is to accomplish the following:

a) Add quick release mounting provisions configuration for EC130 B4 model (1009 configuration)

b) Add cargo basket configuration for EC130 B4 model (1009 configuration).

c) Add cabin step configuration for EC130 B4 model (1010 configuration).

This certification plan details the means and methods of compliance for the addition of the new configurations listed above.

FAR 27 Subpart B - Flight

7.2 27.29 – Empty Weight and Corresponding C of G

7.2.1 Means of Compliance

a) Review, calculate and inspect

7.2.2 Method of Compliance

a) Weight and balance information required to compute the aircraft empty weight and corresponding C of G with the cargo basket, cabin steps and mounting provisions installed is provided on each installation drawing as well as in the Instructions for Continued Airworthiness.

7.2.3 Compliance Documents, Data and Testing

a) Installation drawings: 100901, 100902, 101001

b) Instructions for Continued Airworthiness ICA1009.91 Revision 0 (basket, provisions)

c) Instructions for Continued Airworthiness ICA1010.91 Revision 0 (cabin step)

7.2.4 Level of Delegation

Finding of compliance to FAR 27.29 delegated.

7.2.5 Level of Involvement / Service

None

7.3 27.45, .51, .65, .71, .73, .75, .141, .143, .171, .173, .175, .177, .241, .251 – Flight Requirements and .547 – Main Rotor Structure (Mast Bending)

7.3.1 Means of Compliance

a) Test

7.3.2 Method of Compliance

a) Company flight test to ensure installations do not produce excessive vibration and determine the handling qualities of the aircraft are adequate prior to TCCA flight test, in accordance with Flight Test Plan and Report FTP1009.03.
b) Vibrations on test aircraft configurations to be compared to unmodified aircraft using vibration analysis equipment. Flight test plan and report FTP1009.03 will detail the extent of the vibration analysis pass/fail criteria and a baseline spectrum will be included for comparison.
c) Comprehensive TCCA flight tests to determine flight characteristics and limitations.

7.3.3 Compliance Documents, Data and Testing

a) Flight test plan and report FTP1009.03.
b) Flight test report prepared by TCCA flight test pilot

7.3.4 Level of Delegation

Not delegated

7.3.5 Level of Involvement / Service

a) TCCA to accept flight test plan FTP1009.03.
b) TCCA Flight test
c) Finding of compliance for flight requirements paragraphs

Subpart C – Strength Requirements

7.4 27.301, .303, .305, .307, .337, .625 – Strength Requirements

7.4.1 Means of Compliance

a) Analysis
b) Test

7.4.2 Method of Compliance

a) Analysis to determine applied loads
b) Analysis and load tests to show proof of compliance

7.4.3 Compliance Documents, Data and Testing

a) Engineering Reports: ER1009.01, ER1010.01
b) Load Test Reports: TR1009.02, TR1010.02

7.4.4 Level of Delegation

a) Finding of compliance to FAR 27.301, .303, .305, .307, .337, .561 delegated.

7.4.5 Level of Involvement / Service

a) TCCA to accept air drag loads in ER1009.01, ER1010.01
b) TCCA to accept load test plans TR1009.02, TR1010.02.

7.5 27.471, .473, .501, .549, 571 – Strength Requirements (Landing Gear)

7.5.1 Means of Compliance

a) Review, calculate, and inspect

7.5.2 Method of Compliance

a) Analysis to compare original configuration to new.
b) Statement in report to address the modified forward landing gear attachment configuration. The report addresses the applicable fatigue/ strength /dimensional /protection /hardware /service qualification analysis for these replacement clamps.

7.5.3 Compliance Documents, Data and Testing

a) Engineering Reports: ER1009.01

7.5.4 Level of Delegation

None.

7.5.5 Level of Involvement / Service

a) Finding of compliance to FAR 27.471, .473, 501, .549, .571

Subpart D – Design and Construction

7.6 27.601, .603, .605, .609, .611 – Design Requirements

7.6.1 Means of Compliance

a) Review and inspect

7.6.2 Method of Compliance

a) Specifications on fabrication drawings

7.6.3 Compliance Documents, Data and Testing

a) Fabrication drawings

7.6.4 Level of Delegation

a) Finding of compliance to FAR 27.601, .603, .605, .609, .611 delegated.

7.6.5 Level of Involvement / Service

None.

7.7 27.613 – Material Requirements

7.7.1 Means of Compliance

a) Analysis

7.7.2 Method of Compliance

a) Strength properties in accordance with material specifications and AR-MMPDS-01 as applicable

7.7.3 Compliance Documents, Data and Testing

a) Fabrication drawings

7.7.4 Level of Delegation

a) Finding of compliance to FAR 27.613 delegated.

7.7.5 Level of Involvement / Service

None.

7.8 27.725, .727 – Limit Drop Test / Reserve Energy Drop Test

7.8.1 Means of Compliance

a) Review and inspect.

7.8.2 Method of Compliance

a) Statement in report regarding landing gear deflection
   a. Cabin/crew doors are jettisonable, deflection of basket due to contact with landing gear in an emergency landing condition does not prevent doors from being jettisoned.
   b. AC27-1B, section 27.727A allows for expendable accessories to be damaged by landing gear deformation.

7.8.3 Compliance Documents, Data and Testing

a) Engineering Reports ER1009.01

7.8.4 Level of Delegation

None.

7.8.5 Level of Involvement / Service

a) Finding of compliance to FAR 27.725, .727.

7.9 27.783, .807 – Doors / Emergency Exits

7.9.1 Means of Compliance

a) Review and inspect.

7.9.2 Method of Compliance

a) Statement in report regarding access to cabin doors.
   a. RH crew/cabin door is jettisonable from inside
   b. LH crew door is jettisonable from inside, accessible from aft cabin
b) Evaluate egress while aircraft is configured for flight test.

7.9.3 Compliance Documents, Data and Testing

a) Engineering Reports ER1009.01

7.9.4 Level of Delegation

a) Finding of compliance to FAR 27.807 delegated.

7.9.5 Level of Involvement / Service

a) Finding of compliance to FAR 27.783.

7.10 27.787 – Cargo Compartments

7.10.1 Means of Compliance

a) Analysis

7.10.2 Method of Compliance

a) Compliance with FAR 27.301 through 27.307 and 27.337

7.10.3 Compliance Documents, Data and Testing

a) Engineering Report ER1009.01
b) Load Test Report TR1009.02
c) Fabrication drawings

7.10.4 Level of Delegation

a) Finding of compliance to FAR 27.787 delegated.

7.10.5 Level of Involvement / Service

None.

7.11 27.865 – External Loads

The cargo basket installation is clearly a Class A rotorcraft external load (non-jettisonable, not extending below the landing gear). FAR 27.865 is not used for the cargo basket installation because the operating rules for external loads in the FAA system, Part 133, specifically preclude the carriage of passengers during external loads operations. TCCA permits the carrying of passengers with external loads in CAR 703.25 – Air Taxi Operations, External Loads, when the external load installation is approved by a supplemental type certificate.

To prevent classification as a Class A external load in the FAA system and the requirement to operate under Part 133, the bicycle rack is considered a cargo compartment and uses the loads

specified in FAR 27.787, which are higher than the 2.5g maximum vertical load factor specified in 27.865.

7.12 27.1323 – Airspeed Indicating System

7.12.1 Means of Compliance

a) Test

7.12.2 Method of Compliance

a) Flight Test to demonstrate airspeed indicating system is not affected by modification

   Note: Static port located approx. 24" aft of forward mounting beam on the bottom of the fuselage.

7.12.3 Compliance Documents, Data and Testing

a) Flight Test Plan and Report FTP1009.03

7.12.4 Level of Delegation

None

7.12.5 Level of Involvement / Service

a) Finding of compliance to FAR 27.1323

Subpart G – Operating Limitiations and Information

7.13 27.1501, .1503, .1505, .1525, .1581, .1583(c), .1585, .1587

7.13.1 Means of Compliance

a) Test
b) Flight Manual Supplement

7.13.2 Method of Compliance

a) TCCA flight test to determine limitations
b) Flight Manual Supplement provided which includes operating limitations, operating procedures, performance information and loading information.

7.13.3 Compliance Documents, Data and Testing

Flight Manual Supplement FMS1009.91

7.13.4 Level of Delegation

None

7.13.5 Level of Involvement / Service

a) TCCA to approve FMS1009.91

b) Finding of compliance to FAR 27.1501, .1503, .1505, .1525, .1581, .1583(c), .1585, .1587

7.14 27.1541, 27.1557 – Markings and Placards

7.14.1 Means of Compliance

a) Placard provided

7.14.2 Method of Compliance

a) Placard is engraved aluminum, located conspicuously on basket lid
b) Placard specifies loading limitations

7.14.3 Compliance Documents, Data and Testing

a) Fabrication drawings

7.14.4 Level of Delegation

a) Finding of compliance to FAR 27.1557 delegated.

7.14.5 Level of Involvement / Service

a) Finding of compliance to FAR 27.1541.

7.15 27.1529 - ICA

7.15.1 Means of Compliance

b) Instructions for Continued Airworthiness provided

7.15.2 Method of Compliance

b) Instructions for Continued Airworthiness are prepared in accordance with CAR 527 Appendix A

7.15.3 Compliance Documents, Data and Testing

Instructions for Continued Airworthiness ICA1009.90, ICA1010.90

7.15.4 Level of Delegation

None

7.15.5 Level of Involvement / Service

a) TCCA to accept ICA1009.90, ICA1010.90
b) Finding of compliance to FAR 27.1529

7.16 Schedule

The following schedule is proposed and will be updated as items are changed or completed.

Proposed target completion date: ~~01 June 2015~~

Item	Deliverable	TCCA Level of Involvement / Service	Submission Date (proposed)	Approval / Acceptance (initial)	Date
Flight test plan (Section 7.3.5)	FTP1009.03	Accept test plan			
Flight test report (Section 7.3.5)	FTP1009.03	Accept results			
TCCA Flight test (Section 7.3.5)	Report	Flight test by TCCA pilot	N/A		
Engineering Report – Air Drag Loads (Section 7.4.5)	ER1009.01	Accept air drag loads			
	ER1010.01	Accept air drag loads			
Load test report (Section 7.4.5)	TR1009.02	Accept test plan			
	TR1010.02	Accept test plan			
Engineering Report (Section 7.7.5)	ER1009.01	Finding of compliance to CAR 27.783			
Flight Manual Supplement (Section 7.9.5)	FMS1009.91	Review and approval			
ICA (Section 7.11.5) (MSI 53)	ICA1009.90	Review and acceptance			
	ICA1010.90	Review and acceptance			
Findings of Compliance (Section 7.3.5, 7.7.5, 7.9.5, 7.11.5)	CP1009 (checklist)	Finding of compliance to indicated paragraphs on compliance program checklist (Appendix A)			

APPENDIX A

COMPLIANCE PROGRAM CHECKLIST

APPLICANT:	Aero Design Ltd. 9888 A Malaspina Road Powell River, BC, Canada V8A 0G3	DATE:	11 May 2015
		REVISION No.	1, 29 June 2015
		MAKE:	Airbus Helicopters
CORRESPONDANCE TO: (If other than applicant)		MODEL:	EC130 B4
		REGISTRATION:	All Eligible
		SERIAL No.:	All Eligible

NATURE OF WORK: Quick Release Mounting Provisions Installation; Cargo Basket Installation; Cabin Step Installation

TYPE CERTIFICATE DATA SHEET: H-83

MODEL CERTIFICATION BASIS: AWM 527 at Change 527-3, equivalent to FAR 27 at amendment 32

MODIFICATION CERTIFICATION BASIS: Same as original basis of certification

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
Subpart B - Flight						
27.29	32	Empty Weight and Corresponding C of G	Data specified on inst'n drawing		X	
27.45	32	Performance - General	Flight Test	X		Preliminary flight tests performed by Aero Design in accordance with Flight Test Plan FTP1009.03 Certification flight tests performed by TCCA test pilot
27.51	32	Takeoff data: General	Flight Test	X		
27.65	32	Climb: All Engines Operating	Flight Test	X		
27.71	32	Autorotation Performance	Flight Test	X		
27.73	32	Performance at Min. Operating Speed	Flight Test	X		
27.75	32	Landing	Flight Test	X		
27.141	32	Flight Characteristics – General	Flight Test	X		
27.143	32	Controllability and Maneuverability	Flight Test	X		
27.171	32	Stability – General	Flight Test	X		
27.173	32	Static Longitudinal Stability	Flight Test	X		
27.175	32	Demonstration of Longitudinal Stability	Flight Test	X		
27.177	32	Static Directional Stability	Flight Test	X		
27.241	32	Ground Resonance	Flight Test	X		
27.251	32	Vibration	Flight Test	X		

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
Subpart C – Strength Requirements						
27.301	32	Loads – Air Drag Loads	Analysis	X		
27.301	32	Loads – Inertia Loads	Compliance with 27.337 and 27.561		X	
27.303	32	Factor of Safety	Analysis in ER1009.01		X	
27.305	32	Strength and Deformation	Analysis in ER1009.01 and Test iaw Test Plan TR1009.02		X	
27.307	32	Proof of Structure			X	
27.337(a)	32	Limit Maneuvering Load Factor			X	Critical load factor in vertical direction.
27.471	32	Ground Loads: General	Statement in ER1009.01	X		
27.473	32	Ground Loading Conditions and Assumptions	Statement in r ER1009.01	X		
27.501	32	Ground Loading Conditions: Skid Type Landing Gear	Statement in ER1009.01	X		
27.547	32	Main Rotor Structure	Flight Test	X		
27.549	32	Fuselage, Landing Gear, and Rotor Pylon Structures	Statement in ER1009.01	X		
27.561(b)(3)	32	Occupant Protection	N/A			Not an item of mass inside the cabin
27.561(c)	32	Items of Mass	N/A			Basket is not located above/behind the cabin.
			Statement in ER1009.01			Forward deflection or failure of basket poses no threat to occupants of cabin.
						27.337 Maneuvering Loads are critical vertical loads.
27.561(d)	32	Internal fuel tanks	N/A			Installation not in area of internal fuel tanks below the passenger floor
27.571	32	Fatigue	Analysis in ER1009.01	X		
Subpart D – Design and Construction						
27.601	32	Design	Drawings		X	Design is conventional.
27.603	32	Materials	Drawings		X	Materials as specified in AR-MMPDS-01
27.605	32	Fabrication Methods	Drawings		X	Design is conventional.
27.609	32	Protection of Structure	Drawings		X	

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
27.611	32	Inspection Provisions	Drawings		X	Design is easy to inspect.
27.613	32	Material Strength Properties and Design Values	Values used as per AR-MMPDS-01		X	
27.625	32	Fitting Factor	Analysis in ER1009.01		X	
27.725	32	Limit Drop Test	N/A			Cross tube clamp straps are on bottom of tube, not part of load path in drop test.
27.727	32	Reserve Energy Drop Test	N/A			
27.783	32	Doors	Statement in ER1009.01	X		Cargo basket located is below doors.
27.787(a)	32	Cargo and Baggage Compartments	Compliance with 23.301 through 307		X	
27.787(b)	32	Cargo and Baggage Compartments	Design		X	Basket is a closed container.
27.787(c)(1)	32	Cargo and Baggage Compartments	Statement in ER1009.01		X	Cargo is external to helicopter, position will not restrict escape facilities
27.807	32	Emergency Exits	Statement in ER1009.01		X	Installation does not block doors form opening
27.865	32	External Loads	N/A – Statement in CP1009			
27.952(b)	32	Fuel System Crash Resistance – *Fuel tank load factors*	N/A – statement in ER1009.01			No change from Type Approved configuration
27.952(e)	32	Fuel System Crash Resistance – *Separation of fuel and ignition sources*	N/A – statement in ER1009.01			No change from Type Approved configuration
27.1323	32	Airspeed Indicating System	Flight Test	X		To be checked during flight test
27.1387	32	Position Light System Dihedral Angles	N/A – statement in ER1009.01			No change from Type Approved configuration
27.1401	32	Anticollision Light System	N/A – statement in ER1009.01			No change from Type Approved configuration
Subpart G – Operating Limitations and Information						
27.1501	32	General	Compliance with 27.1503 - 27.1525 and 27.1541 - 27.1589 as indicated below	X		
27.1503	32	Airspeed Limitations: General	Flight Test	X		
27.1505	32	Never Exceed Speed	Flight Test, Flight Manual Supplement FMS1009.91	X		V_{NE} limits to be determined by flight test
27.1525	32	Kinds of Operation	FMS1009.91	X		Limited to VFR only.
27.1529	32	Instructions for Continued Airworthiness	ICA Provided, ICA1009.90	X		
27.1541	32	Markings and Placards - General	Compliance with 27.1557 below	X		Placard is engraved aluminum, installed on basket lid

Airworthiness Requirement	FAR 27 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
27.1557(a)	32	Miscellaneous Markings and Placards – Baggage Compartments	Placard on lid		X	
27.1581	32	Rotorcraft Flight Manual – General	FMS1009.91	X		
27.1583(c)	32	Operating Limitations – Weight and Loading Information	FMS1009.91	X		
27.1585	32	Operating Procedures	FMS1009.91	X		
27.1587	32	Performance Information	FMS1009.91	X		
27.1589	32	Loading Information	FMS1009.91 & Placard	X		Placard installed on basket lid
AWM 527 Requirements						
527.1581 (e)	3	Flight Manual – Metric Units	FMS1009.91	X		Metric units provided

APPENDIX B

CHANGED PRODUCT RULE DECISION RECORD

Aero Design Ltd. CPR Decision Record CPR-DR1009, Revision 0, 19 March 2015

CHANGED PRODUCT RULE (CPR) DECISION RECORD		
NAPA No.:		
Step 1: Identify the proposed change to the aeronautical product. (Section 4.1 of AC 500-016)	The changes are detailed in the listed document(s): Certification Plan CP1009, Revision 0.	
Note: A G-1 Issue Paper <u>may</u> be required to track/document the decisions at Step 2 and Steps 5 through 8, and to detail the concluded certification basis.		
Step 2: Is the change substantial? (Section 4.2 of AC 500-016)	☐ Yes ☒ No	A new type certificate is required. CPR Decision Process is **Closed.** Proceed to Step 3
Step 3: Will the latest standards be used? (Section 4.3 of AC 500-016)	☐ Yes ☒ No	Certification basis to use latest standards. **Proceed to Step 8.** Proceed to Step 4.
Step 4: Group changes into related and unrelated groupings. (Section 4.4 of AC 500-016)	You may need to define the project in the format of the AC's example for Step 4. Note: For multiple groupings, continuation of this process should be split to separate decision records.	
Step 5: Is the proposed change significant? (Section 5.0 of AC 500-016)	☐ Yes ☒ No	Proceed to **Decision.** Compliance may be shown to earlier standards. Certification basis to be defined and documented as indicated (below). **Proceed to Step 8.**
Decision: Will the latest standards be used?	☐ Yes ☐ No	Certification basis to use latest standards. **Proceed to Step 8.** Proceed to Step 6, addressing each area separately (see below).
Identification of Affected Areas:	The area(s) affected by the proposed change have been detailed in Certification Plan document number(s): CP1009, Revision 0	
Step 6: Is this area affected by the proposed change? (Ask for each area) (Section 6.1 of AC 500-016)	☐ Yes ☐ No	Proceed to Step 7. Compliance with the latest standards is not required. Compliance may be continued to be shown with the existing certification basis.
Step 7: Do the latest standards contribute materially to the level of safety and are they practical? (Section 6.2 of AC 500-016) ☐ Continuation Sheet(s) Attached	☐ Yes ☐ No	Certification basis to be established using latest standards. Compliance with the latest standards is not required. Compliance may be shown to earlier standards. Certification Basis defined or documented as indicated in below. **Note:** Several standards may apply to each area and the assessment may differ from standard to standard. Indicate Yes if compliance with any latest standard(s) will be required. Indicate No only if earlier standards are to be applied.
Note:	A delegate may develop a proposal for the Yes/No decision of Step 7. TCCA will make the final determination.	
Step 8: Is the proposed Basis of Certification Adequate? (Section 8.0 of AC 500-016)	☒ Yes ☐ No	**Stop!** CPR Decision Process is **Closed.** Determination of Certification Basis is Complete! Basis of certification may require later airworthiness standards or Special Conditions – Consult TCCA.
Certification Basis	The certification basis is as follows or as detailed in the listed document(s): Refer to Certification Plan CP1009	

Under the delegated authority, I have examined the change in type design listed above according to established procedures and hereby determine, to the best of my knowledge and belief, that it is. (check one)

☐ substantial, pursuant to section 521.153 of the CARs

☐ significant, pursuant to subsection 521.158(3) of the CARs

☒ not significant, pursuant to subsection 521.158(3) of the CARs

James Tinson

James Tinson, DAR 304

APR 2 3 2015

Date

Wings Project No: WPN 1507

ENGINEERING REPORT

ER1009.01

AIRBUS HELICOPTERS EC130 B4

QUICK RELEASE MOUNTING PROVISIONS
QUICK RELEASE CARGO BASKET

COMPLIANCE REPORT

Reviewed by Jason 13 July 2015

Prepared by: Jeff Clarke, P.Tech.(Eng.)

Revision 0, 13 July 2015

Aero Design Ltd.

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TABLE OF CONTENTS

1.0 INTRODUCTION

This report details the method of compliance for the paragraphs of FAR 27 listed in Certification Plan CP1009. It includes:

- generation of the applied loads to be used for the analysis and load testing used in the structural certification of the cargo basket and mounts
- analysis of reactions on the airframe
- certification statements related to ground clearance, doors, and lights.

2.0 REFERENCE TEXT

Eurocopter EC130 Illustrated Parts Book

Eurocopter Standard Practices Manual

Eurocopter System Description Section (SDS) Manual

Aero Design Ltd. Certification Plan CP1009, Revision 1, 29 June 2015, External Mounting Provisions Installation, Quick Release Cargo Basket Installation, and Quick Release Cabin Step Installation

Aero Design Ltd. Engineering Report ER842.01, Revision 0, 14 October 2011, Cargo Basket Handle - Load Test Report, approved by E. Burgoin DAR 290M

-test for supporting inertia load of cargo by handle and hinge assembly remains valid.

-test of handle latching remains valid

Aero Design Ltd. Test Plan and Report TR959.05, Revision 0, 14 March 2014, Bell 429 Cargo Basket Lid and Front Panel Load Test Report, approved by J. Tinson DAR 304

-test for supporting air drag load on lid with basket mounted upside down on upside down mounting provisions (section 5.1) is valid to demonstrate the negative maneuvering condition.

Aero Design Ltd. Load Test Plan and Report TR1009.02, Revision 0, dated XX

Aero Design Ltd. Installation Drawings:

100901, Revision 0 – Cargo Basket Installation

100902, Revision 0 – Quick Release Mounting Beams Installation

100903, Revision 0 – External Attachment Provisions Installation

Aero Design Ltd. Fabrication Drawings:

100910, Revision 0 – Cargo Basket Assembly

100911, Revision 0 – Basket Body Assembly

94012, Revision 1 – Lid Assembly

100915, Revision 0 – Forward Beam Assembly

100916, Revision 0 – Aft Beam Assembly

100930, Revision 0 – Forward Fitting Fabrication
100931, Revision 0 – Aft Fitting Fabrication
100932, Revision 0 – Forward Beam Fabrication
100933, Revision 0 – Aft Beam Fabrication
100934, Revision 0 – Forward Down Tube Fabrication
100935, Revision 0 – Aft Down Tube Fabrication

3.0 BASIS OF CERTIFICATION

Refer to Certification Plan CP1009, Revision 1, section 5.3 for the applicable basis of certification.

4.0 LOADS

4.1 Load Factors

Quick Release Cargo Basket - EC130

FAR 27.561(b)(3)

	Ultimate Upward Emergency Landing Load Factor:	$n_{e\_up} := 1.5$
	Ultimate Forward Emergency Landing Load Factor:	$n_{e\_fwd} := 4.0$
	Ultimate Sideward Emergency Landing Load Factor:	$n_{e\_side} := 2.0$
	Ultimate Downward Emergency Landing Load Factor:	$n_{e\_down} := 4.0$
FAR 27.625	Fitting Factor (does not apply to articles being tested):	$n_{ff} := 1.15$
FAR 27.303	Safety Factor:	$n_{sf} := 1.5$
FAR 27.337(a)		
	Limit Positive Maneuvering Load Factor:	$n_{man} := 3.5$
$n_{man\_ult} := n_{man} \cdot n_{sf}$	Ultimate Positive Maneuvering Load Factor:	$n_{man\_ult} = 5.25$
	Limit Negative Maneuvering Load Factor:	$n_{man\_neg} := -1.0$
$n_{man\_neg\_u} := n_{man\_neg} \cdot n_{sf}$	Ultimate Negative Maneuvering Load Factor:	$n_{man\_neg\_u} = -1.5$

CRITICAL ULTIMATE LOAD FACTORS:

Downward:	Ultimate Positive Maneuvering Load Factor:	$n_{man\_ult} = 5.25$
Forward:	Ultimate Forward Emergency Landing Load Factor:	$n_{e\_fwd} = 4$
Sideward:	Ultimate Sideward Emergency Landing Load Factor:	$n_{e\_side} = 2$
Upward:	Ultimate Upward Emergency Landing Load Factor:	$n_{e\_up} = 1.5$

Note: The basket is mounted below and to one side of the cabin. Forward deflection or failure in the emergency landing condition does not endanger the occupants. Likewise, Sideward and Upward deflection or failure of the basket in the emergency landing condition do not endanger the occupants.

Sideward and Upward Load Factors are used in the tests to ensure that the lid of the basket does not open in flight.

4.2 Loads Overview

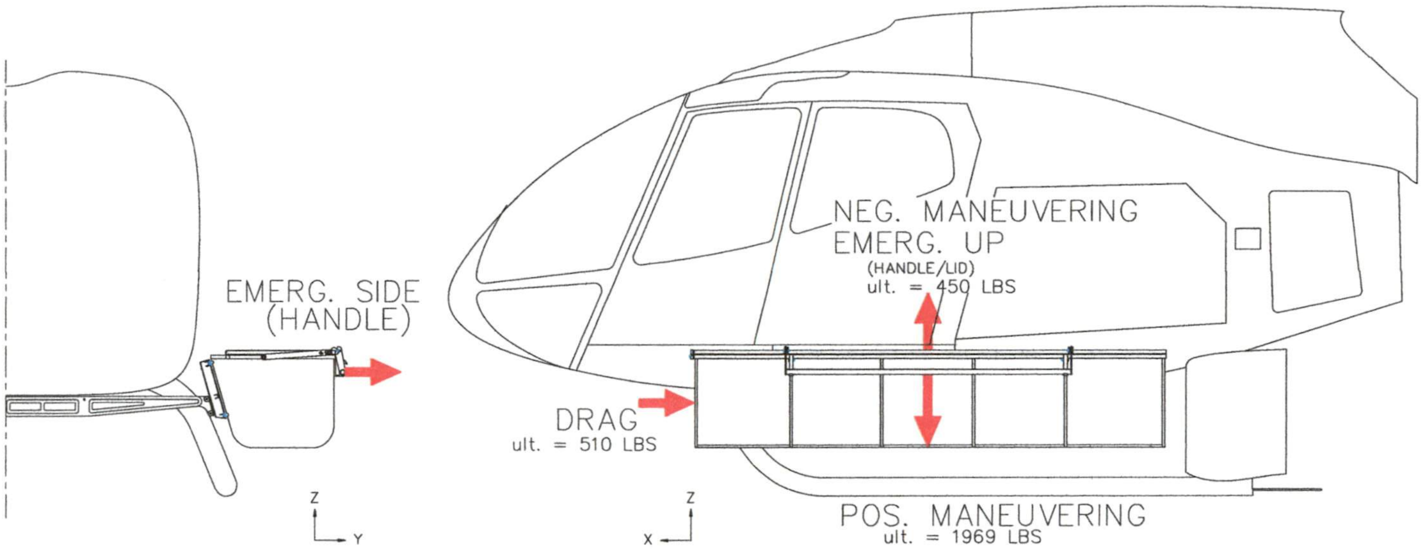


Figure 4.2.1 – Overview of Applied Loads

4.3 Inertia Loads

4.3.1 Weights

$W_{basket} := 75 \cdot lbf$ Weight of basket (including options, basic basket is less)

$W_{cargo} := 300 \cdot lbf$ Weight of cargo (max)

$W_{beam} := 23 \cdot lbf$ Weight of mounting beam (each)

$W_{handle} := 4.5 \cdot lbf$ Weight of handle assembly

4.3.2 Positive Maneuvering Load

$P_{man\_lim} := \left(W_{basket} + W_{cargo}\right) \cdot n_{man\_lim}$

$P_{man\_lim} = (75 \cdot lbf + 300 \cdot lbf) \cdot 3.5$

$P_{man\_lim} = 1313 \cdot lbf$ Limit maneuvering load due to cargo and basket

$P_{man\_ult} := P_{man\_lim} \cdot n_{sf}$

$P_{man\_ult} = 1312.5 \cdot lbf \cdot 1.5$

$P_{man\_ult} = 1969 \cdot lbf$ Ultimate maneuvering load due to cargo and basket

$P_{man\_lim\_beam} := W_{beam} \cdot n_{man\_lim}$

$P_{man\_lim\_beam} = 23 \cdot lbf \cdot 3.5$

$P_{man\_lim\_beam} = 81 \cdot lbf$ Limit maneuvering load due to beam

$P_{man\_ult\_beam} := P_{man\_lim\_beam} \cdot n_{sf}$

$P_{man\_ult\_beam} = 80.5 \cdot lbf \cdot 1.5$

$P_{man\_ult\_beam} = 121 \cdot lbf$ Ultimate maneuvering load due to beam

4.3.3 Negative Maneuvering Load / Emergency Upward Load

The ultimate negative maneuvering load and emergency upward load factors are the same. The mounting provisions must support the negative maneuvering load due to the basket and cargo. The lid and handle arrangement must restrain the cargo under the negative maneuvering load condition.

$P_{man\_neg\_lim} := \left(W_{basket} + W_{cargo}\right) \cdot n_{man\_neg}$

$P_{man\_neg\_lim} = (75 \cdot lbf + 300 \cdot lbf) \cdot (-1.0)$

$P_{man\_neg\_lim} = -375 \cdot lbf$ Limit maneuvering load due to cargo and basket

$P_{man\_neg\_ult} := P_{man\_neg\_lim} \cdot n_{sf}$

$P_{man\_neg\_ult} = (-375.0) \cdot lbf \cdot 1.5$

$P_{man\_neg\_ult} = -563 \cdot lbf$ Ultimate maneuvering load due to cargo and basket

$P_{man\_neg\_lim\_cargo} := \left(W_{cargo}\right) \cdot n_{man\_neg}$

$P_{man\_neg\_lim\_cargo}$ explicit, $P_{man\_neg\_lim\_cargo}, W_{cargo}, n_{man\_neg} = 300 \cdot lbf \cdot (-1.0)$

$P_{man\_neg\_lim\_cargo} = -300 \cdot lbf$ Limit maneuvering load due to cargo only

$P_{man\_neg\_ult\_cargo} := P_{man\_neg\_lim\_cargo} \cdot n_{sf}$

$P_{man\_neg\_ult\_cargo} = (-300.0) \cdot lbf \cdot 1.5$

$P_{man\_neg\_ult\_cargo} = -450 \cdot lbf$ Ultimate maneuvering load due to cargo only

4.3.4 Emergency Side Load

The handle must remain latched under the emergency side load condition.

$P_{e\_side} := W_{handle} \cdot n_{e\_side}$

$P_{e\_side} = 4.5 \cdot lbf \cdot 2.0$

$P_{e\_side} = 9 \cdot lbf$ Ultimate sideware load on handle assembly

4.4 Drag Load

$l_{basket} := 96.5 \cdot in$ Length of basket.

$w_{basket} := 25.5 \cdot in$ Width of basket.

$h_{basket} := 19.75 \cdot in$ Height of basket.

$A_f := 443 \cdot in^2 = 3.1\,ft^2$ Frontal Area of basket.

$A_p := l_{basket} \cdot w_{basket}$

$A_p = 2461 \cdot in^2 = 17.1\,ft^2$ Planar Area of basket.

$\frac{l_{basket}}{w_{basket}} = 3.8$ Fineness ratio of basket

$C_{Do} := 1.1$ Drag Coefficient of Basket, (overestimated) (Ref. Hoerner, Fluid Dynamic Drag, Figure 22).

$\rho := 0.002378 \cdot \frac{slug}{ft^3}$ Density of air at Sea Level.

$V_{ne} := 155 \cdot knots = 262\,\frac{ft}{s}$ Never-Exceed-Speed of EC130. (Ref. TCDS H-83.)

$V_d := \frac{V_{ne}}{0.9}$

$V_d = 172 \cdot knots = 291\,\frac{ft}{s}$ Design Dive Speed of EC130

$$P_{drag\_lim} := \frac{\rho}{2} \cdot V_d^{\,2} \cdot A_f \cdot C_{Do}$$

$$P_{drag\_lim} = \frac{0.002378 \cdot \frac{slug}{ft^3}}{2} \cdot \left(290.683 \cdot \frac{ft}{s}\right)^2 \cdot 3.076 \cdot ft^2 \cdot 1.1$$

$P_{drag\_lim} = 340 \cdot lbf$ — Limit Drag load on basket.

$$P_{drag\_ult} := P_{drag\_lim} \cdot n_{sf}$$

$$P_{drag\_ult} = 339.938 \cdot lbf \cdot 1.5$$

$P_{drag\_ult} = 510 \cdot lbf$ — Ultimate Drag load on basket.

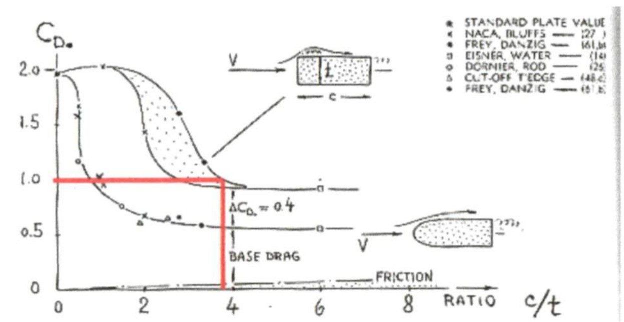


Figure 22. Drag coefficient of "rectangular" sections (tested between walls) with blunt leading edge (upper part) and with rounded shape (lower part), against length ratio.

Figure 4.4.1 – Figure 22, Chapter 3, from Fluid Dynamic Drag by Hoerner

5.0 STRUCTURAL ANALYSIS

5.1 Combined Positive Maneuvering and Drag Load Condition

Structural compliance for the basket assembly, mounting beams, and attachment fittings is demonstrated by test, see load test plan and report TR1009.02. The required applied loads are:

P_{man_lim} = 1313 lbs Limit positive maneuvering load due to basket and cargo
P_{drag_lim} = 340 lbs Limit drag load

P_{man_ult} = 1969 lbs Ultimate positive maneuvering load due to basket and cargo
P_{drag_ult} = 510 lbs Ultimate drag load

5.2 Negative Maneuvering Load Condition

The required applied loads are:

$P_{man\_neg\_lim}$ = 375 lbs Limit negative maneuvering load due to basket and cargo
$P_{man\_neg\_ult}$ = 563 lbs Ultimate negative maneuvering load due to basket and cargo

The basket assembly and mounting configuration using horizontal keyways and vertical keyways with one vertical keyway blocked by a pin has been demonstrated to support 550 lbs plus the weight of the basket (71 lbs) with no permanent deformation, reference TR959.05, Rev. 0. The EC130 configuration basket is similar to the basket tested, and the mounting provisions at the basket attachment are identical to the configuration tested, therefore the results of the testing in TR959.05 are valid for this installation.

The stainless steel tube section of the mounting beams is symmetrical, therefore the bending moment applied to the tube by the positive maneuvering condition is sufficient to demonstrate the negative maneuvering condition.

The aluminum section of the mounting beams is symmetrical, therefore the bending moment applied to the aluminum beam by the positive maneuvering condition is sufficient to demonstrate the negative maneuvering condition.

The fasteners attaching the stainless steel tube section to the aluminum beam have been demonstrated to support the positive maneuvering condition, which is sufficient to demonstrate the negative maneuvering condition.

5.3 Forward Emergency Landing Load Condition

The basket is located below the cabin. Forward deflection of the basket does not endanger the occupants in a crash.

5.4 Upward Emergency Landing Load Condition

The lid and handle configuration have been demonstrated to restrain the cargo under the upward emergency landing load condition, reference Engineering Report ER842.01. The lid assembly tested in ER842.01 is the same size as the lid assembly in this configuration, and the hinge and handle arrangement tested is identical.

5.5 Sideward Emergency Landing Load Condition

The handle has been demonstrated to remain latched under the sideward emergency landing condition, reference Engineering Report ER842.01. The handle in this configuration is identical to the handle tested in ER842.01.

5.6 Helicopter Attachments

The critical load condition is the positive maneuvering load combined with drag. The reactions on the airframe are shown on figures 5.6.1 and 5.6.2.

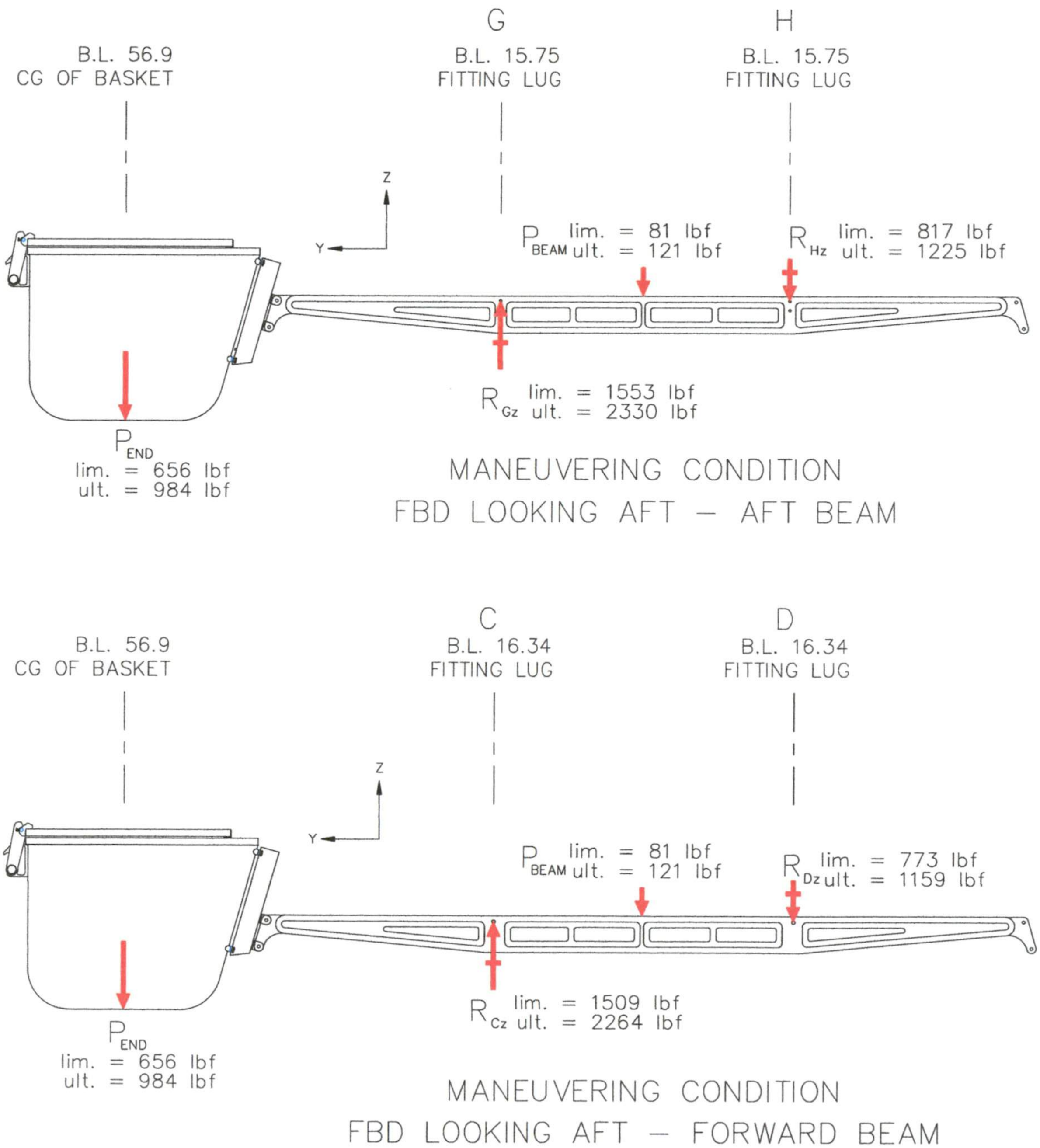


Figure 5.6.1 – Helicopter Reactions, Maneuvering Load

$$P_{end\_lim} := \frac{P_{man\_lim}}{2}$$

$$P_{end\_lim} = \frac{1312.5 \cdot lbf}{2}$$

$$P_{end\_lim} = 656 \cdot lbf$$ Limit maneuvering load on each end of basket at attachments

$$P_{end\_ult} := \frac{P_{man\_ult}}{2}$$

$$P_{end\_ult} = \frac{1968.75 \cdot lbf}{2}$$

$$P_{end\_ult} = 984 \cdot lbf$$ Ultimate maneuvering load on each end of basket at attachments

Maneuvering reactions on airframe - aft is critical as attachments are closer together.
Sum moments about G:

$$R_{Hz} := \frac{P_{end\_ult} \cdot 41.12 \cdot in - P_{man\_ult\_beam} \cdot 15.75 \cdot in}{31.5 \cdot in}$$

$$R_{Hz} = \frac{984.375 \cdot lbf \cdot 41.12 \cdot in - 120.75 \cdot lbf \cdot 15.75 \cdot in}{31.5 \cdot in}$$

$$R_{Hz} = 1225 \cdot lbf$$ Ultimate vertical reaction at H

Sum forces in Z direction:

$$R_{Gz} := R_{Hz} + P_{end\_ult} + P_{man\_ult\_beam}$$

$$R_{Gz} = 1224.625 \cdot lbf + 984.375 \cdot lbf + 120.75 \cdot lbf$$

$$R_{Gz} = 2330 \cdot lbf$$ Ultimate vertical reaction at G

Maneuvering reactions on airframe - forward.
Sum moments about C:

$$R_{Dz} := \frac{P_{end\_ult} \cdot 40.5 \cdot in - P_{man\_ult\_beam} \cdot 16.34 \cdot in}{32.69 \cdot in}$$

$$R_{Dz} = \frac{984.375 \cdot lbf \cdot 40.5 \cdot in - 120.75 \cdot lbf \cdot 16.34 \cdot in}{32.69 \cdot in}$$

$$R_{Dz} = 1159 \cdot lbf$$ Ultimate vertical reaction at D

Sum forces in Z direction:

$$R_{Cz} := R_{Dz} + P_{end\_ult} + P_{man\_ult\_beam}$$

$$R_{Cz} = 1159.20 \cdot lbf + 984.375 \cdot lbf + 120.75 \cdot lbf$$

$$R_{Cz} = 2264 \cdot lbf$$ Ultimate vertical reaction at C

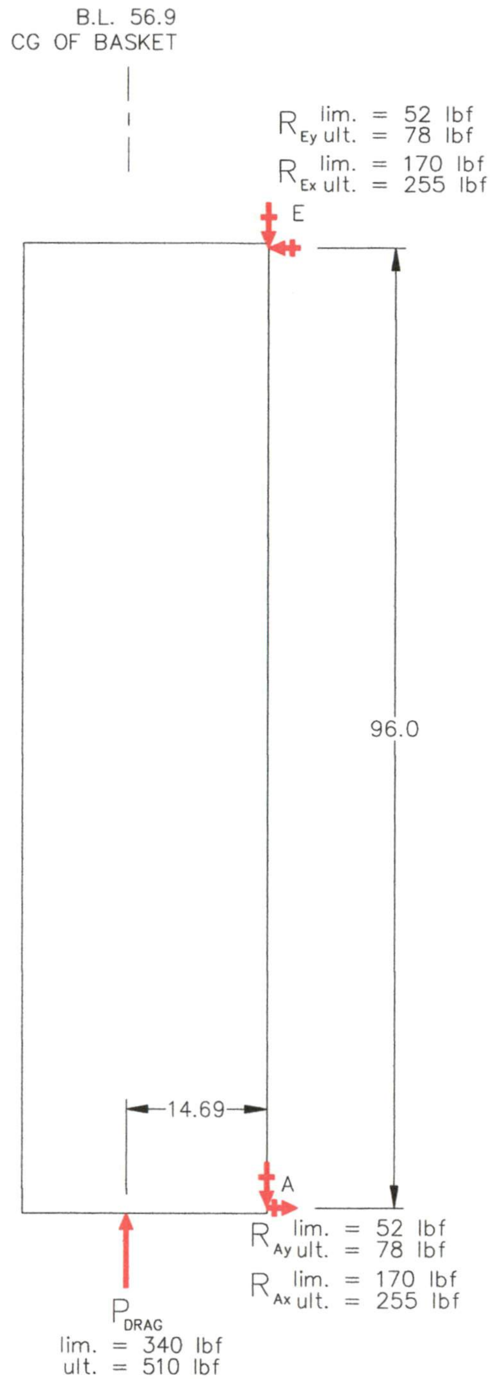


Figure 5.6.2 – Basket Attachment Reactions, Drag Load

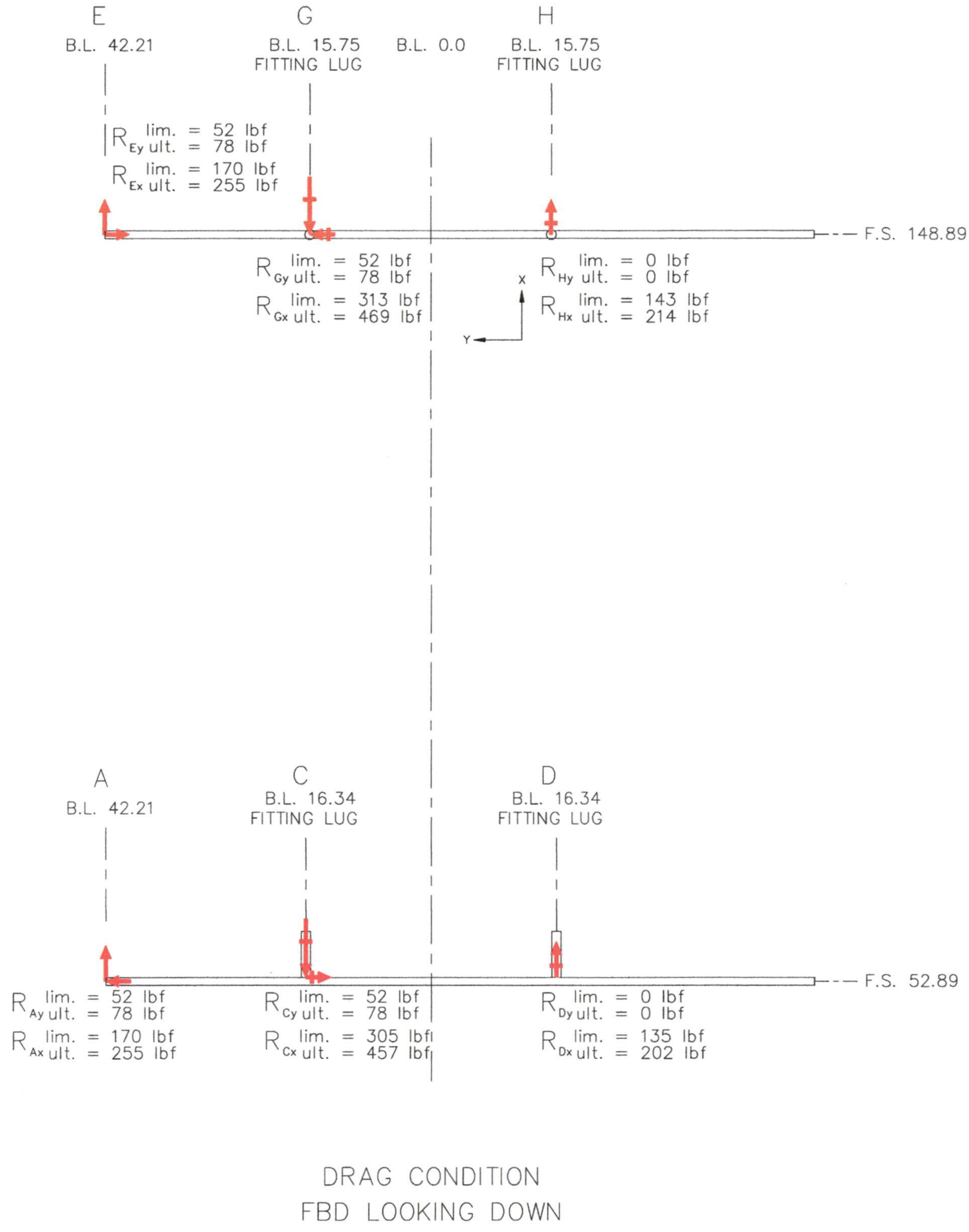


Figure 5.6.3 – Helicopter Reactions, Drag Load

Assumes lateral reactions at A and E are carried by closest point, C and G respectively.

Lateral reaction due to drag. Sum moments about E:

$$R_{Ay} := \frac{P_{drag\_ult} \cdot 14.69 \cdot in}{96.0 \cdot in}$$

$$R_{Ay} = \frac{509.907 \cdot lbf \cdot 14.69 \cdot in}{96.0 \cdot in}$$

$R_{Ay} = 78 lbf$ Ultimate lateral reaction at A

Sum forces in Y direction:

$$R_{Ey} := R_{Ay}$$

$R_{Ey} = 78 lbf$ Ultimate lateral reaction at E

Drag reactions on airframe, aft beam. Sum moments about G:

$$R_{Hx} := \frac{0.5 \cdot P_{drag\_ult} \cdot (42.21 \cdot in - 15.75 \cdot in)}{31.5 \cdot in}$$

$$R_{Hx} = \frac{0.5 \cdot 509.907 \cdot lbf \cdot (42.21 \cdot in - 15.75 \cdot in)}{31.5 \cdot in}$$

$R_{Hx} = 214 \cdot lbf$ Ultimate longitudinal reaction at H

Sum forces in X direction:

$$R_{Gx} := R_{Hx} + 0.5 \cdot P_{drag\_ult}$$

$$R_{Gx} = 214.161 \cdot lbf + 0.5 \cdot 509.907 \cdot lbf$$

$R_{Gx} = 469 \cdot lbf$ Ultimate longitudinal reaction at G

Drag reactions on airframe, forward beam. Sum moments about C:

$$R_{Dx} := \frac{0.5 \cdot P_{drag\_ult} \cdot (42.21 \cdot in - 16.34 \cdot in)}{32.69 \cdot in}$$

$$R_{Dx} = \frac{0.5 \cdot 509.907 \cdot lbf \cdot (42.21 \cdot in - 16.34 \cdot in)}{32.69 \cdot in}$$

$R_{Dx} = 202 \cdot lbf$ Ultimate longitudinal reaction at D

Sum forces in X direction:

$$R_{Cx} := R_{Dx} + 0.5P_{drag\_ult}$$

$$R_{Cx} = 201.763 \cdot lbf + 0.5 \cdot 509.907 \cdot lbf$$

$R_{Cx} = 457 \cdot lbf$ Ultimate longitudinal reaction at C

5.6.1 Forward Attachment

Reaction at point C – applied downward and aft

The downward load due to the cargo basket installation is applied to the strap fitting under the cross tube. Strength of this part was demonstrated by the test in section 5.1. The positive maneuvering load also applies the load due to the landing gear on this fitting.

$P_{ult\_man\_pos\_LG} = W_{LG} \times n_{ult\_man\_pos}$

$P_{ult\_man\_pos\_LG} = 88.12 \text{ lbs} \times 5.25g$

88.12 lbs = weight of landing gear (ref: System Description Section, 32-11-00)

5.25g = ultimate positive maneuvering load factor

$P_{ult\_man\_pos\_LG} = 463 \text{ lbs}$ Ultimate positive maneuvering load due to landing gear

Note the weight of the landing gear includes the cabin access steps which are removed.

The landing gear is attached to the fuselage at 3 points, noted at Detail A (forward) and B (aft) on figure 5.6.4. The forward strap fitting is replaced by the strap fitting with hardpoint (100930-01), item 9 in Detail A.

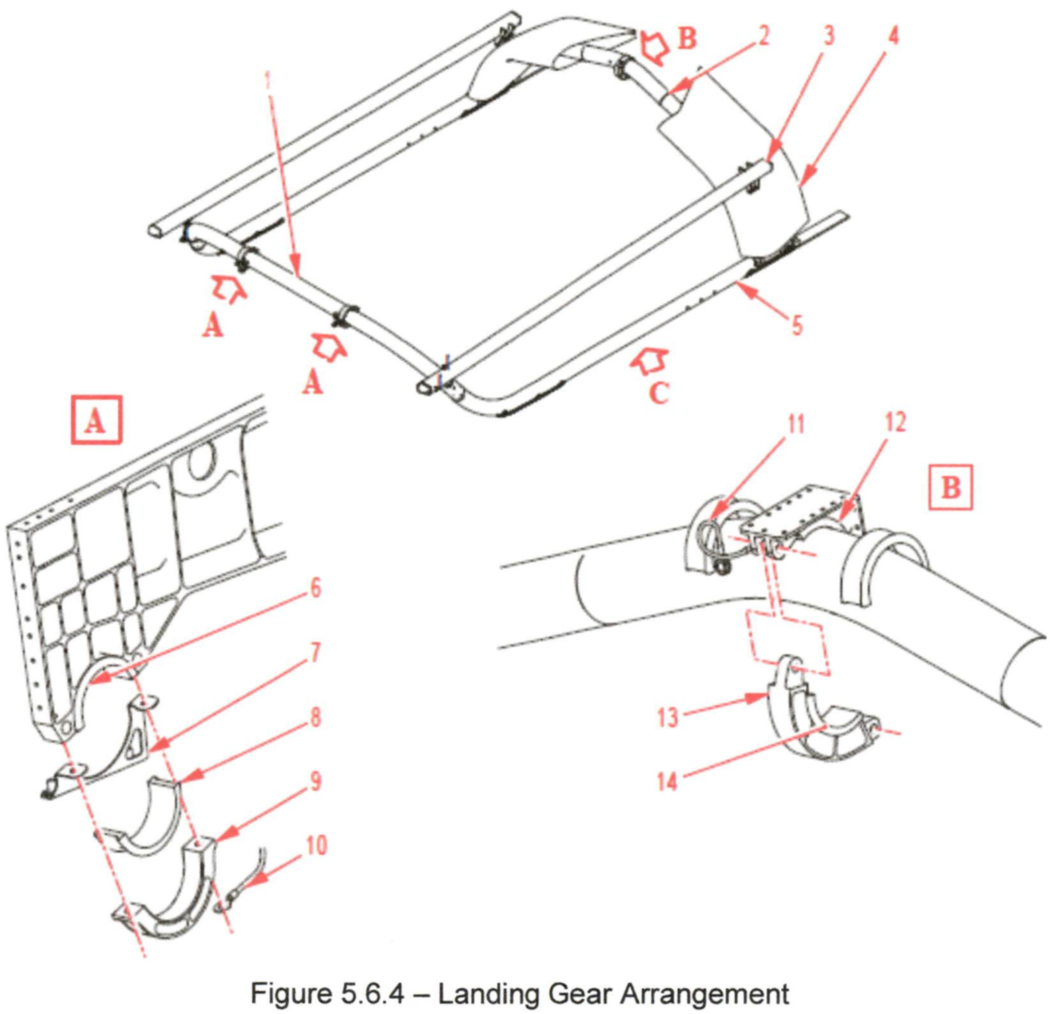


Figure 5.6.4 – Landing Gear Arrangement

(Ref: EC130 System Description Manual)

Assuming the load is split equally front to back, and equally side to side at the front:

$P_{ult\_man\_pos\_LG\_fitting} = P_{ult\_man\_pos\_LG} / 2 / 2$

$P_{ult\_man\_pos\_LG\_fitting} = 115.7$ lbs — Ultimate positive maneuvering load on each forward strap

The strap fitting must also support the loads generated by airflow over the cross tubes at V_D combined with the maneuvering load. The centre section of the forward cross tube is inside fuselage fairings and therefore does not produce any drag to be applied to the landing gear attachments. The vertical section of the cross tubes are inclined to the airflow, creating lift and drag loads. Lift and drag from the horizontal section is of the skid tubes is minimal and is not considered.

$\alpha := 55 \cdot deg$ — Angle of incidence of forward section of landing gear to airflow (Reference station drawing)

$C_{Lo} := 1.1 \cdot \sin(\alpha)^2 \cdot \cos(\alpha)$

$C_{Lo} = 0.42$ — Coefficient of lift for cylinders inclinded to airflow (Ref: Hoerner, Chapter 3, Fig. 18)

$C_{Do} := 1.1 \cdot \sin(\alpha)^3 + 0.02$

$C_{Do} = 0.62$ — Coefficient of drag for cylinders inclinded to airflow (Ref: Hoerner, Chapter 3, Fig. 18)

$A_{f\_LG} := 22.7 \cdot in \cdot 3.55 \cdot in$

$A_{f\_LG} = 81 \cdot in^2 = 0.6 \cdot ft^2$ — Frontal area of landing gear (each side)

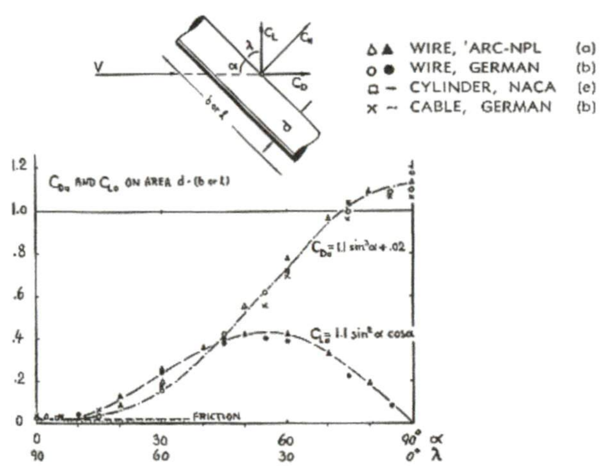


Figure 18. Drag (and lift) coefficients (on area "d" times axial length "l") of circular cylinders, wires and cables; inclined against the direction of flow – at Reynolds numbers below the critical. Reference (21).

Figure 5.6.5 - Figure 18, Chapter 3, from Fluid Dynamic Drag by Hoerner

$$P_{lift\_LG} := \frac{1}{2} \cdot \rho \cdot V_d^{\,2} \cdot A_{f\_LG} \cdot C_{Lo}$$

$$P_{lift\_LG} = \frac{1}{2} \cdot 0.002378 \cdot \frac{slug}{ft^3} \cdot \left(290.683 \cdot \frac{ft}{s}\right)^2 \cdot 0.56 \cdot ft^2 \cdot 0.42$$

$P_{lift\_LG} = 24 \cdot lbf$ Lift on inclined section of cross tube @ Vd (each side)

$$P_{lift\_ult\_LG} := P_{lift\_LG} \cdot n_{sf}$$

$$P_{lift\_ult\_LG} = 23.6 \cdot lbf \cdot 1.5$$

$P_{lift\_ult\_LG} = 35 lbf$ Ultimate lift on inclined section of cross tube @ Vd (each side)

$$P_{drag\_LG} := \frac{1}{2} \cdot \rho \cdot V_d^{\,2} \cdot A_{f\_LG} \cdot C_{Do}$$

$$P_{drag\_LG} = \frac{1}{2} \cdot 0.002378 \cdot \frac{slug}{ft^3} \cdot \left(290.683 \cdot \frac{ft}{s}\right)^2 \cdot 0.56 \cdot ft^2 \cdot 0.63$$

$P_{drag\_LG} = 35 \cdot lbf$ Drag on inclined section of cross tube @ Vd (each side)

$$P_{drag\_ult\_LG} := P_{drag\_LG} \cdot n_{sf}$$

$$P_{drag\_ult\_LG} = 35.45 \cdot lbf \cdot 1.5$$

$P_{drag\_ult\_LG} = 53 lbf$ Ultimate drag on inclined section of cross tube @ Vd (each side)

Landing gear fitting reaction loads.
Sum moments about S (aft attachment):

$$R_{T\_t} := \frac{R_{Cx} \cdot 4.49 \cdot in + R_{Cz} \cdot 4.43 \cdot in + P_{ult\_man\_pos\_LG\_fitting} \cdot 2.51 \cdot in - P_{lift\_ult\_LG} \cdot 2.51 \cdot in + P_{drag\_ult\_LG} \cdot 0.69 \cdot in}{5.21 \cdot in}$$

$$R_{T\_t} = \frac{456.717 \cdot lbf \cdot 4.49 \cdot in + 2264.325 \cdot lbf \cdot 4.43 \cdot in + 115.7 \cdot lbf \cdot 2.51 \cdot in - 35.4 \cdot lbf \cdot 2.51 \cdot in + 53.18 \cdot lbf \cdot 0.69 \cdot in}{5.21 \cdot in}$$

$R_{T\_t} = 2365 \cdot lbf$ Ultimate tensile reaction at T

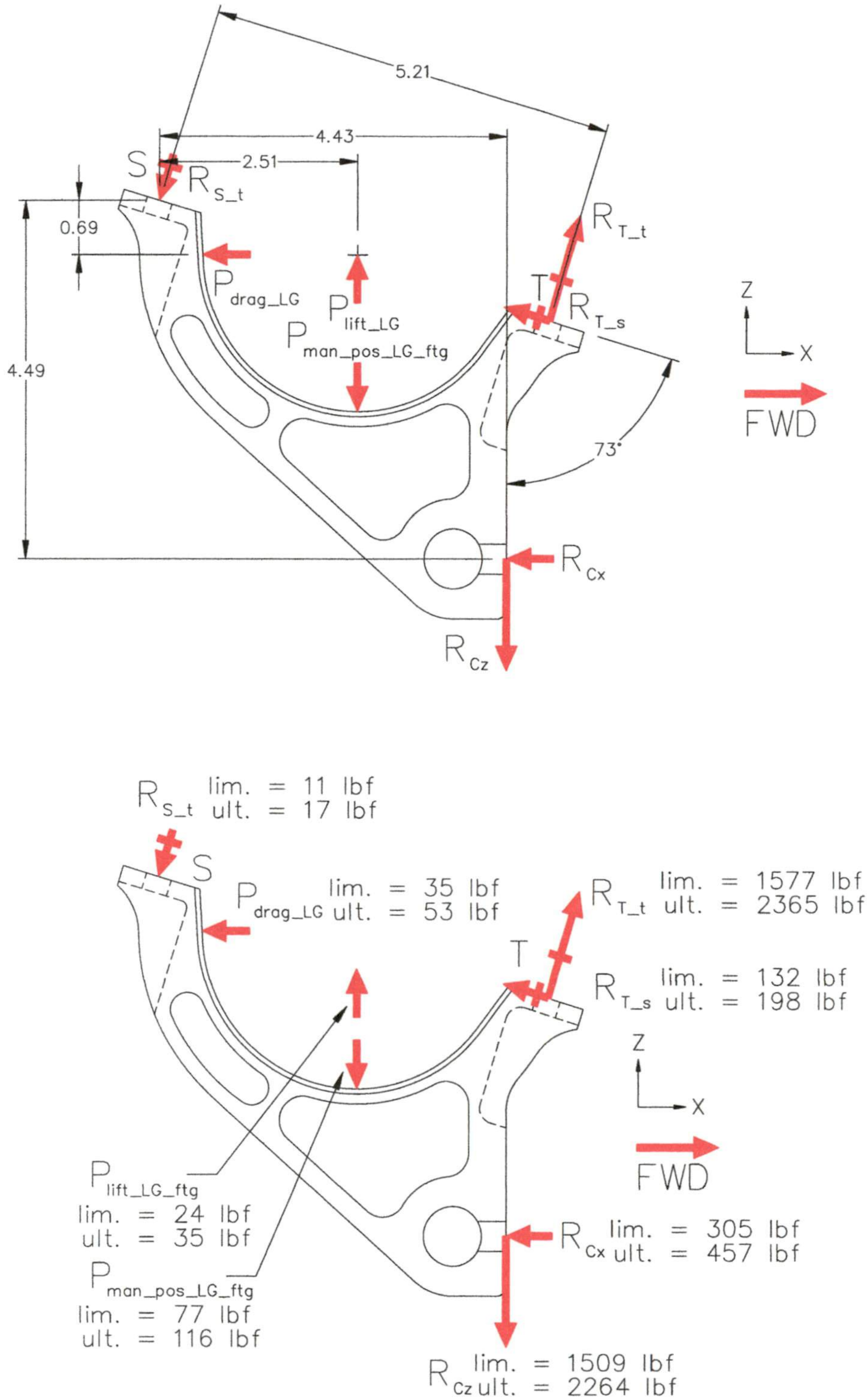


Figure 5.6.6 – Forward Landing Gear Fitting, Downward Load (Point C)

Equation solving:

$x = R_{T\_s}$ Assume shear is carried at T, noted by "x"

$y = R_{S\_t}$ Tension on S, noted by "y"

Sum forces horizontally:

$$-x \cdot \cos(17 \cdot deg) + R_{T\_t} \cdot \sin(17 \cdot deg) - y \cdot \sin(17 \cdot deg) = R_{Cx} + P_{drag\_ult\_LG}$$

Sum forces vertically:

$$x \cdot \sin(17 \cdot deg) + R_{T\_t} \cdot \cos(17 \cdot deg) - y \cdot \cos(17 \cdot deg) = P_{ult\_man\_pos\_LG\_fitting} + R_{Cz} - P_{lift\_ult\_LG}$$

$$\begin{pmatrix} R_{T\_s} \\ R_{S\_t} \end{pmatrix} := \mathrm{Find}(x, y)$$ (Solves above equations for x and y)

$R_{T\_s} = 198 \cdot lbf$ Ultimate shear reaction on T

$R_{S\_t} = -27 \cdot lbf$ Ultimate tension reaction on S

The strength of the strap fitting is significantly higher than the fasteners that attach it to the airframe, refer to Section 6.0 for strength of the fitting sections. The fasteners used to install the forward landing gear strap are P/N 22201BE080016L bolts, 8 mm diameter (0.315 inch), per the Illustrated Parts Book, and are retained for this installation.

The Eurocopter Standard Practices Manual provides fastener material code "BE" is 35CD4 steel with tensile strength of 1080 / 1280 MPa (157 / 186 ksi), reference Eurocopter Standard Practices Manual section 20-02-05-103. Using AR-MMPDS-01, the ultimate tensile strength of the bolt is 8590 lbs, for a 160 ksi tensile stress bolt of 0.312 inch diameter (8 mm = 0.315 inch).

$P_{T\_BE08\_bolt} := 8590 \cdot lbf$ Ultimate tensile strength of 8mm BE bolt (reference rationale above)

$$MS := \left(\frac{P_{T\_BE08\_bolt}}{R_{T\_t} \cdot n_{ff}} \right) - 1$$

$$MS = \frac{8590 \cdot lbf}{2364.658 \cdot lbf \cdot 1.15} - 1$$

$MS = 2.2$ Margin of Safety is positive

The bolts are secured with SL50M8A barrel nuts. The minimum axial tensile strength of the barrel nut is 10900 lbs (reference Shur-Lok data sheet SL50M), the barrel nut is sufficient.

The barrel nuts for the cross tube straps are enclosed in a solid section at the bottom of the main longitudinal beams, see figure 5.6.7. There are webs in the beam on either side of both attachment points for the cross tube strap. The longitudinal beams are 30 mm (1.18 inches) wide, and the webs are 3 mm (0.12 inches) wide. The specific aluminum alloy and temper of the beam is not known, but is expected to be 7175 aluminum or similar high strength material. To be conservative, the material properties of 6061-T6 aluminum are used, and the material on the inboard face of the beam is ignored.

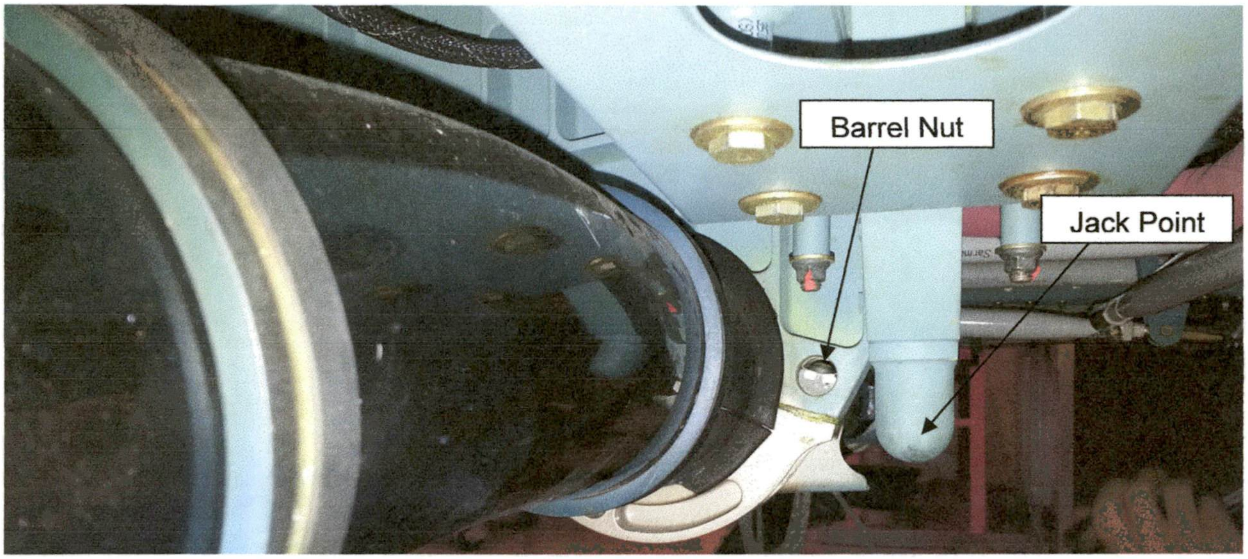


Figure 5.6.7 – Forward Landing Gear Structure, Forward Side

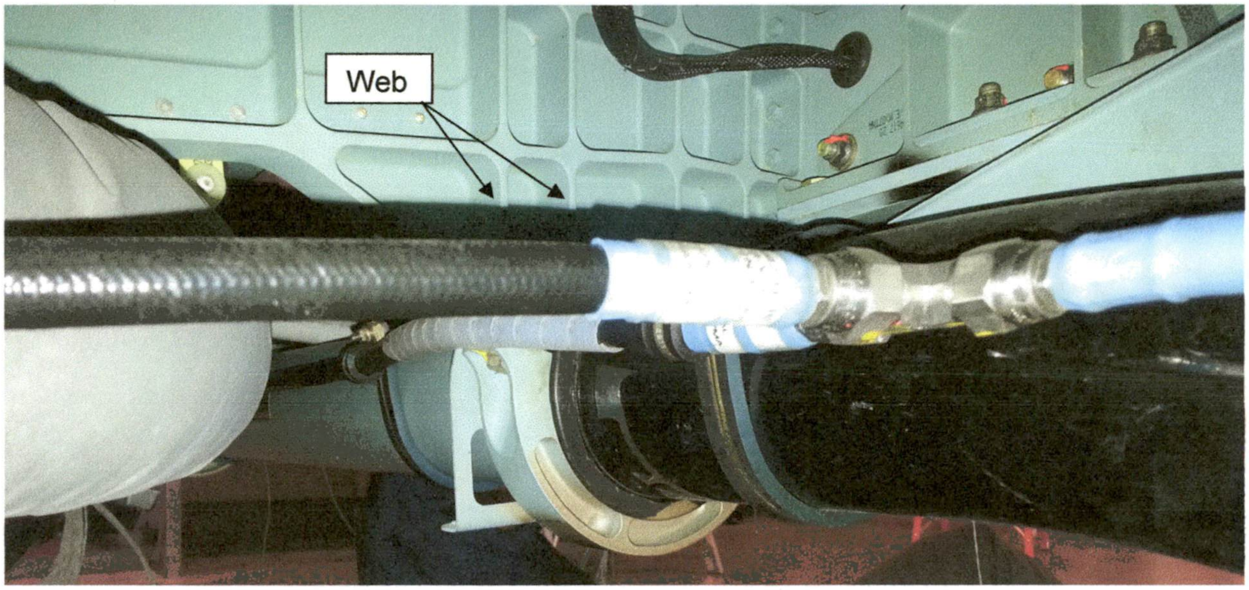


Figure 5.6.8 – Forward Landing Gear Structure, Aft Side

$F_{Tu\_6061} := 33 \cdot ksi$ — Ultimate tensile strength of 6061-T6 Aluminum Extruded bar, LT direction (ref: AR-MMPDS-01)

$A_{web} := 1.18 \cdot in \cdot 0.118 \cdot in$

$A_{web} = 0.14 \cdot in^2$ — Cross sectional area of web, ignoring inboard face

$R_{T\_t} = 2365 \cdot lbf$ — Tensile reaction on bolt T

$$f_{tu\_web} := \frac{R_{T\_t}}{2 \cdot A_{web}}$$

$$f_{tu\_web} = \frac{2364.658 \cdot lbf}{2 \cdot 0.14 \cdot in^2}$$

$$f_{tu\_web} = 8.4ksi$$

Ultimate tensile stress on webs

$$MS := \frac{F_{Tu\_6061}}{f_{tu\_web} \cdot n_{ff}} - 1$$

$$MS = \frac{33 \cdot ksi}{8.445 \cdot ksi \cdot 1.15} - 1$$

$$MS = 2.4$$

Margin of Safety is positive

The ultimate tensile load applied by the cargo basket installation does not exceed the ultimate tensile strength of 6061-T6 material. The margin of safety for the actual structure is higher.

Upward reaction at point D – upward and forward

The upward load due to the cargo basket installation is applied upward at the landing gear attachments into the airframe. Jacking points for raising the helicopter are also attached at this location, see figure 5.6.7.

The weight of the aircraft is applied to the structure at 3 points, 2 forward and 1 rear. The maximum gross weight of the EC130B4 is 5351 lbs per the TCDS. Assuming the load is split equally front to back, and equally side to side at the front:

$$P_{GW\_fitting} := \left(\frac{5351 \cdot lbf}{2}\right) \cdot \frac{1}{2}$$

$$P_{GW\_fitting} = 1338lbf$$

Upward load on fuselage at forward landing gear attachment at maximum gross weight

$$R_{Dz} = 1159lbf$$

Upward load at point D

$$MS := \left(\frac{P_{GW\_fitting}}{R_{Dz}}\right) - 1$$

$$MS = \frac{1338 \cdot lbf}{1159.20 \cdot lbf} - 1$$

$$MS = 0.2$$

Margin of Safety is positive

The upward load on the airframe due to the maximum gross weight of the helicopter sitting on the landing gear (or jack points), neglecting any additional load factor due to the prescribed landing conditions in FAR 27, is greater than the load applied by the cargo basket installation in the positive maneuvering and combined drag load condition.

5.6.2 Aft Attachment

Reaction at point G – downward and aft

The aft mounting provisions for the cargo basket are installed using the existing fastener locations on the outboard ends of the aft fuel cell cross member, see figure 5.6.7 detail A (item 320/330/350 and 310/340/350). The fuel cell cross member incorporates the aft attachments for the cargo swing when Service Bulletin SB25-032 is incorporated, which does not include any modifications to the longitudinal beams. The cross member must support the fuel cell loads and the cargo swing loads simultaneously. The cargo swing cannot be used with the cargo basket provisions installed, therefore the maximum allowable loads on the airframe for the cargo swing may be applied to the cargo basket provisions.

Helicopter Allowable Reactions - Cargo Hook

$P_{hook} := 2557 \cdot lbf$ Maximum cargo swing hook load (Ref: EC130 Description and operation manual)

$n_{865} := 2.5$ Limit load factor for external load (FAR 27.865)

$P_{hook\_ult} := P_{hook} \cdot n_{865} \cdot n_{sf}$

$P_{hook\_ult} = 9589 \cdot lbf$ Ultimate load on cargo swing

The cargo swing is attached by cables to 4 points located in the lateral frame members supporting the fuel cell.

$$P_{hook\_attach\_ult} := \frac{P_{hook\_ult}}{4}$$

$P_{hook\_attach\_ult} = 2397 \cdot lbf$ Ultimate load on each attachment of cargo swing

The cargo hook load may be applied up to 30 degrees from vertical. The applied load from the cargo basket installation includes downward (maneuvering) and aft (drag) components, so the swing load angle is checked to ensure both conditions can be met simulatneously.

$\theta := 11.3 \cdot deg$ Angle from vertical

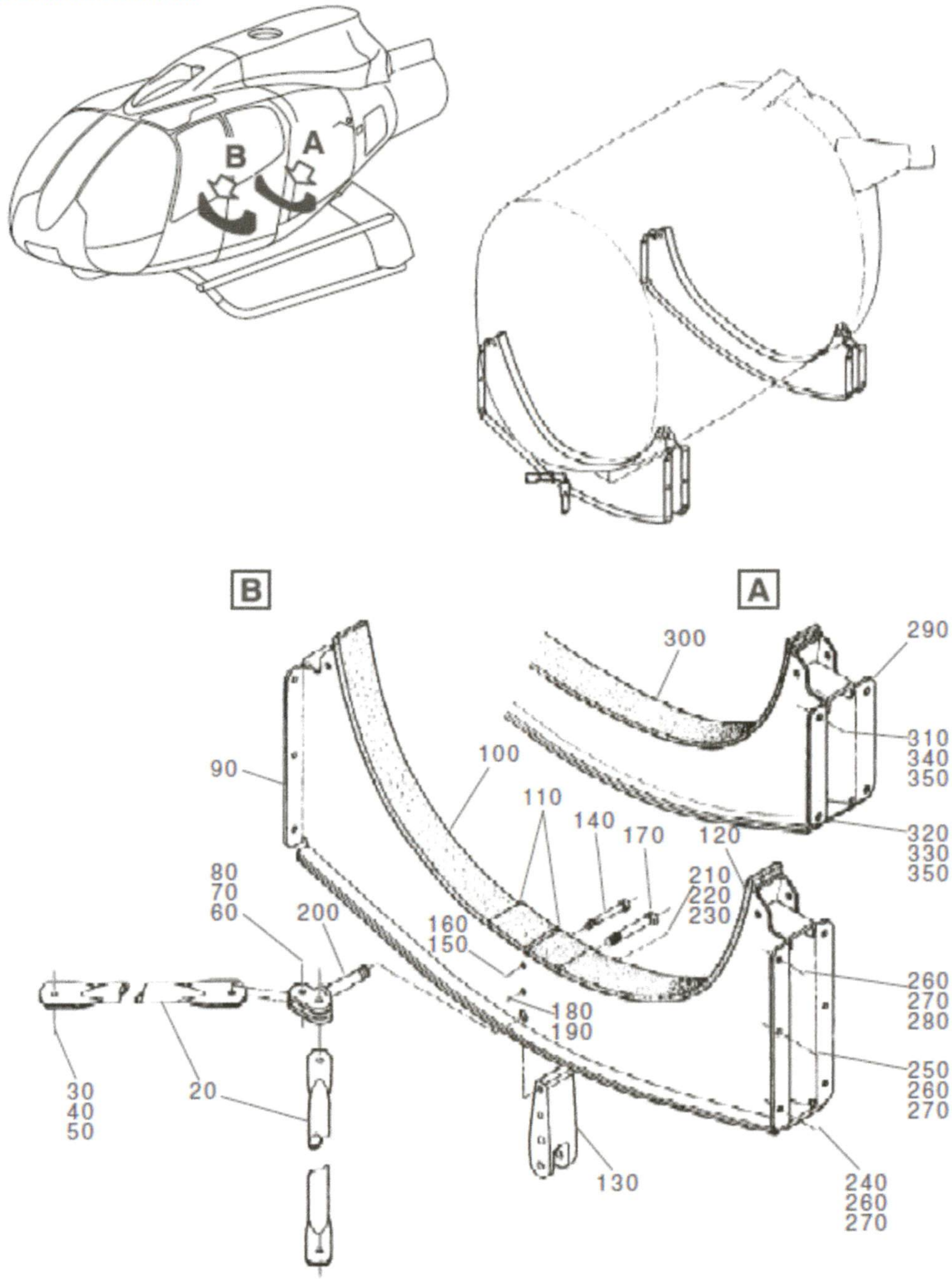
$P_{hook\_z} := P_{hook\_attach\_ult} \cdot \cos(\theta)$

$P_{hook\_z} = 2351 \cdot lbf$ Ultimate vertical component of cargo swing load

$P_{hook\_x} := P_{hook\_attach\_ult} \cdot \sin(\theta)$

$P_{hook\_x} = 470 \cdot lbf$ Ultimate horizontal component of cargo swing load

FRAMEWORK INST. TANKS SUPPORT



25-91-02-03 Page 1/3

Figure 5.6.9 – Fuel Cell Framework Assembly
(Ref: EC130 IPC)

$$MS_z := \left(\frac{P_{hook\_z}}{R_{Gz}}\right) - 1$$

$$MS_z = \frac{2350.72 \cdot lbf}{2329.750 \cdot lbf} - 1$$

$MS_z = 0.009$ Margin of Safety in Z direction is positive (11.3 deg)

$$MS_x := \left(\frac{P_{hook\_x}}{R_{Gx}}\right) - 1$$

$$MS_x = \frac{469.720 \cdot lbf}{469.1145 \cdot lbf} - 1$$

$MS_x = 0.001$ Margin of Safety in X direction is positive (11.3 deg)

$\theta := 13.6 \cdot deg$ Angle from vertical

$P_{hook\_z} := P_{hook\_attach\_ult} \cdot \cos(\theta)$

$P_{hook\_z} = 2330 \cdot lbf$ Ultimate vertical component of cargo swing load

$P_{hook\_x} := P_{hook\_attach\_ult} \cdot \sin(\theta)$

$P_{hook\_x} = 564 \cdot lbf$ Ultimate horizontal component of cargo swing load

$$MS_z := \left(\frac{P_{hook\_z}}{R_{Gz}}\right) - 1$$

$$MS_z = \frac{2329.98 \cdot lbf}{2329.750 \cdot lbf} - 1$$

$MS_z = 0$ Margin of Safety in Z direction is positive (13.6 deg)

$$MS_x := \left(\frac{P_{hook\_x}}{R_{Gx}}\right) - 1$$

$$MS_x = \frac{563.680 \cdot lbf}{469.1145 \cdot lbf} - 1$$

$MS_x = 0.202$ Margin of Safety in X direction is positive (13.6 deg)

The margin of safety is positive for the combined maneuvering and drag loads due to the basket installation when the allowable load for the cargo hook is applied between 11.3 and 13.6 degrees. The loads on the airframe due to the cargo basket installation do not exceed the allowable loads established by the cargo swing installation.

Reaction at point H – upward and forward

The upward reaction load at point H due to the positive maneuvering load serves to reduce the downward load on the airframe due to the fuel cell. The forward reaction to the drag load is lower than the load at point G. The reaction at point G is critical.

5.7 Dual Basket Installation

Installation of baskets on both sides in the critical positive maneuvering condition changes the reactions on the airframe as shown on figure 5.7.1. The downward load on each fitting is less than the load applied to the fitting closest to the basket in the single basket configuration. The bending moment on the mounting beams remains constant over the centre section.

Bending stresses on the beam were analyzed at the changes in cross-section. The critical locations are: (1) at the inboard end of the outboard cutout, and (2) at the centre cutouts between points G and H. The first location is demonstrated by the test in 5.1 and remains valid in the dual basket configuration. The second location may not be effectively demonstrated in the test as the bending moment begins to reduce along the beam to the opposite attachment in the single basket configuration. Point R referenced below is at any point in the centre cutouts of the beam as the bending moment is constant and the beam has constant section through the cutouts.

At R - Dual basket installation

$I_{x\_R} := 4.147 \cdot in^4$ Moment of inertia about x axis at R

$$f_{bx\_R} := \frac{(P_{end\_ult} \cdot 41.1 \cdot in) \cdot 2.0 \cdot in}{I_{x\_R}}$$

$$f_{bx\_R} = \frac{984.375 \cdot lbf \cdot 41.1 \cdot in \cdot 2.0 \cdot in}{4.147 \cdot in^4}$$

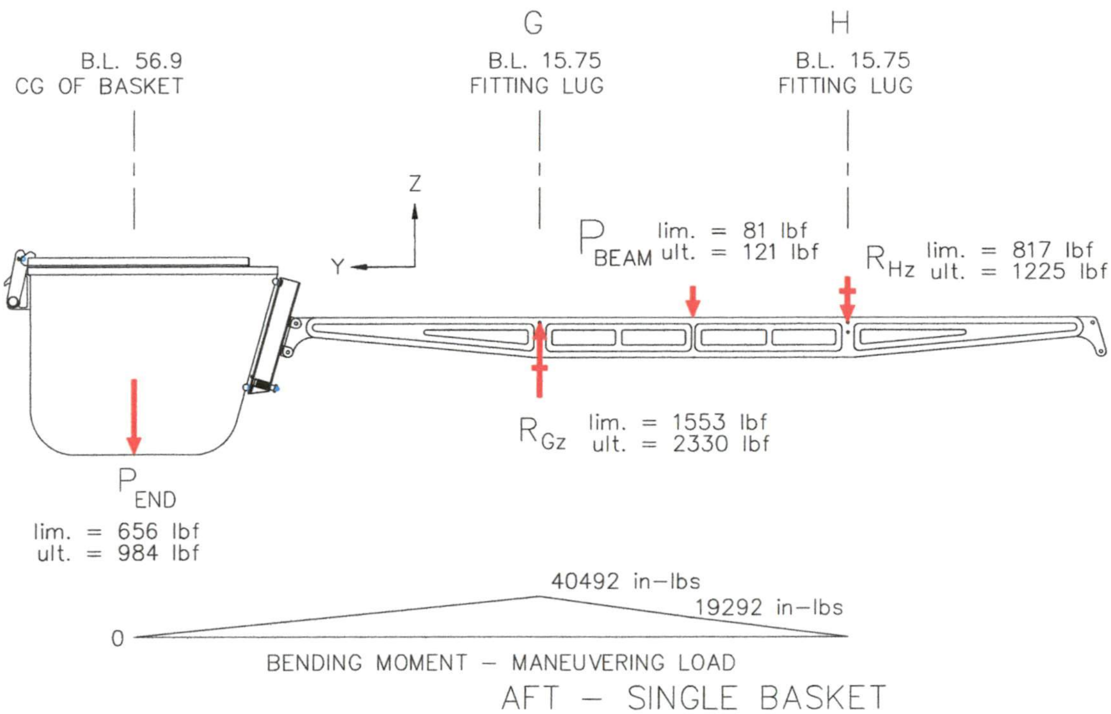
$f_{bx\_R} = 20ksi$ Bending stress at R due to positive maneuvering load

$I_{z\_R} := 0.109 \cdot in^4$ Moment of inertia about z axis at R

$$f_{bz\_R} := \frac{(R_{Ex} \cdot 41.1 \cdot in) \cdot 0.5 \cdot in}{I_{z\_R}}$$

$$f_{bz\_R} = \frac{254.9535 \cdot lbf \cdot 41.1 \cdot in \cdot 0.5 \cdot in}{0.109 \cdot in^4}$$

$f_{bz\_R} = 48ksi$ Bending stress at R due to drag load



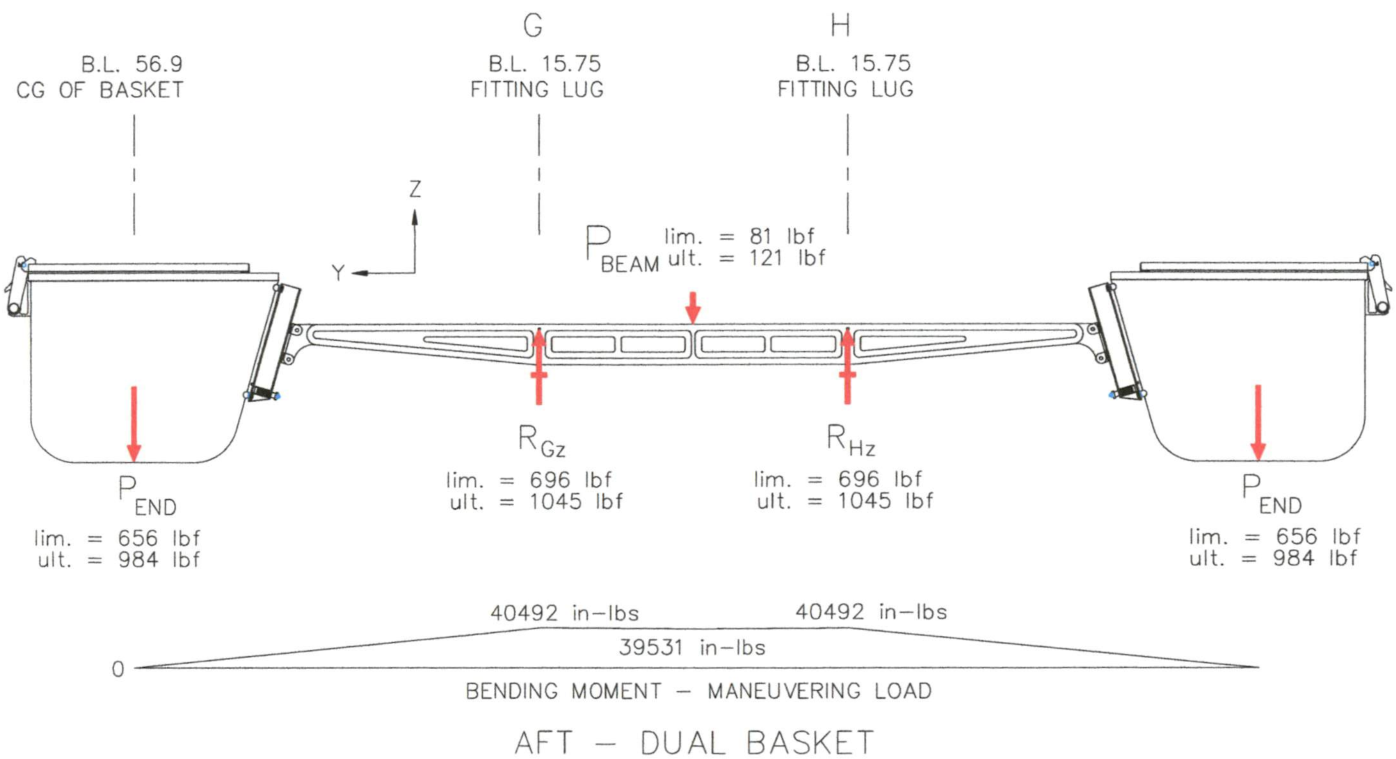


Figure 5.7.1 – Comparison of Reaction Loads, Single Basket vs. Dual Basket

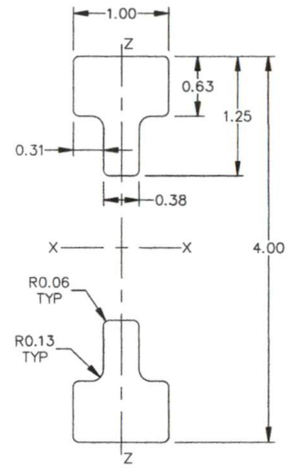


Figure 5.7.2 – Section at R

$f_{b\_R} := f_{bx\_R} + f_{bz\_R}$

$f_{b\_R} = 19.512 \cdot ksi + 48.067 \cdot ksi$

$f_{b\_R} = 68ksi$ Combined bending stress at R

$F_{tu\_7075} = 81ksi$ Ultimate tensile strength of 7075-T6 Aluminum bar (ref: AR-MMPDS-01)

$$MS := \left(\frac{F_{tu\_7075}}{f_{b\_R}}\right) - 1$$

$MS = 0.2$ Margin of safety is positive

6.0 COMPLIANCE WITH FAR 27.471, .473, .501, .549, .571 – LANDING GEAR

This installation replaces the original forward landing gear strap fitting with a new strap fitting incorporating a hard point for installing the mounting beams. A comparison of the fitting properties is provided below. Refer to figure 6.0.1 and 6.0.2

Property	Original Fitting	New Fitting	% change
Material	7175 Aluminum Plate (ref: email from Airbus Helicopters, Appendix A)	7075-T6511 Aluminum Extruded Bar (ref: drawing 100930)	
Ultimate tensile stress	68.1 ksi[A]	81 ksi[B]	+19%
Area, section A-A L / R as shown on fig	0.954 in^2 0.477 in^2 / 0.477 in^2	0.964 in^2 0.505 in^2 / 0.459 in^2	+1% +6% / -4%
Ultimate tensile load L / R as shown on fig	64967 lbs 32483 lbs / 32483 lbs	78084 lbs 40905 lbs / 37179 lbs	+20% +26%/+14%
Area, section B-B	0.466 in^2	0.588 in^2	+26%
Ultimate tensile load	31735 lbs	47628 lbs	+50%
Fatigue		See section 6.1	
Dimensions	Refer to figure 6.0.1	Refer to figure 6.0.2	
	Identical at fuselage interface and in cross tube seat (inside radius)		
Finish	Alodine, epoxy primer and finish paint (ref: Standard Practices Manual, Maintenance Manual)	Alodine, epoxy primer and finish paint (ref: drawing 100930)	
Attaching Fasteners	22201BE080016L Bolt 23111AG080LE Washer SL50M8A Barrel Nut (ref: IPC)	22201BE080016L Bolt 23111AG080LE Washer SL50M8A Barrel Nut (ref: drawing 100903)	
Inspection	Maintenance Manual Chapter 32-11-00, Section 6-1	Existing paragraphs applicable, ICA1009.90	
Installation/Removal	Maintenance Manual Chapter 32-11-00, Section 4-1	ICA1009.90	

[A] Ultimate tensile strength of 7175-T7351 rolled plate is 470 MPa for plate 25 – 40 mm thick (1 – 1.6 inch) per European specification ASNA 3050

[B] Ultimate tensile strength of 7075-T6511 extruded bar is 81 ksi for 0.75-1.5 inch thick per AR-MMPDS-01

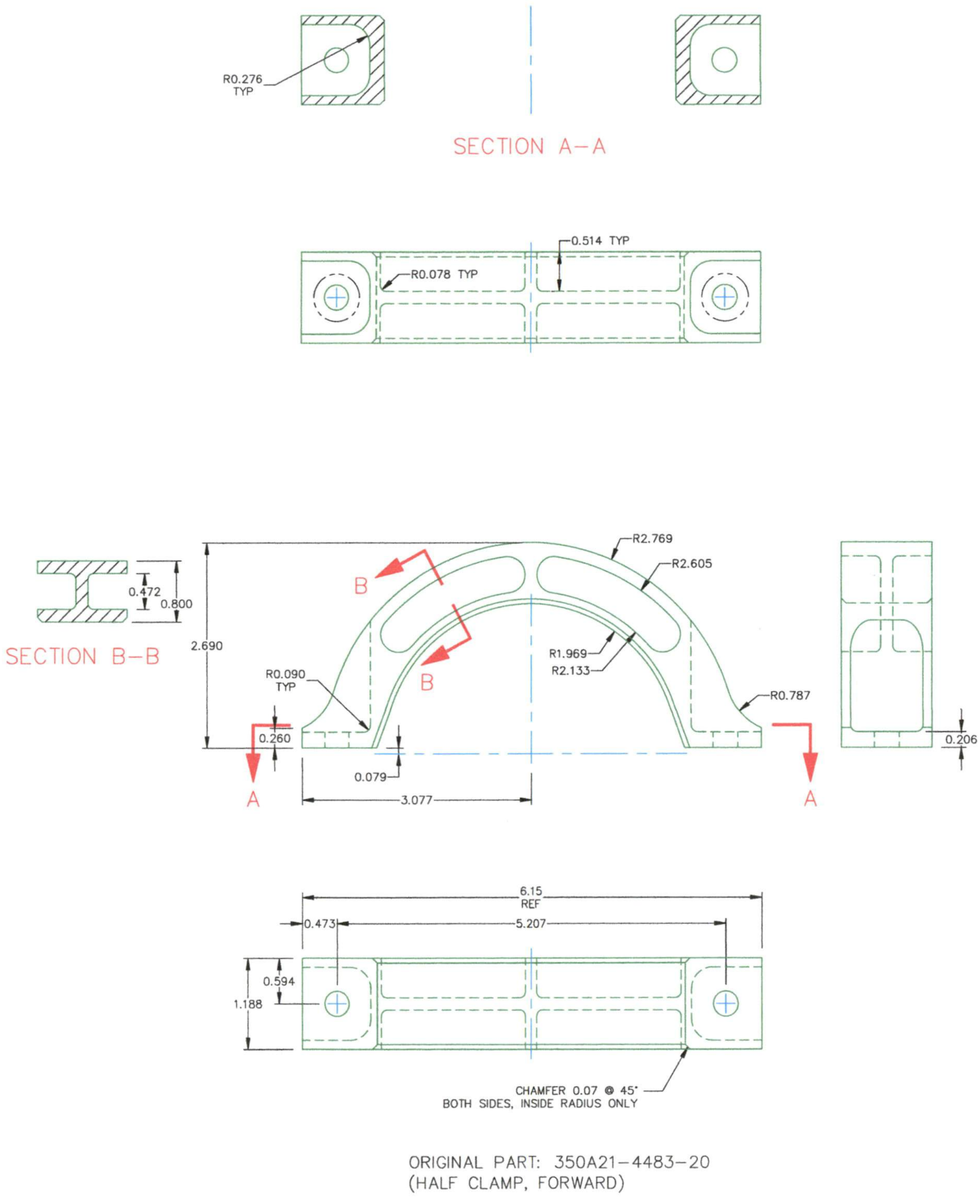


Figure 6.0.1 – Original Strap (as measured)

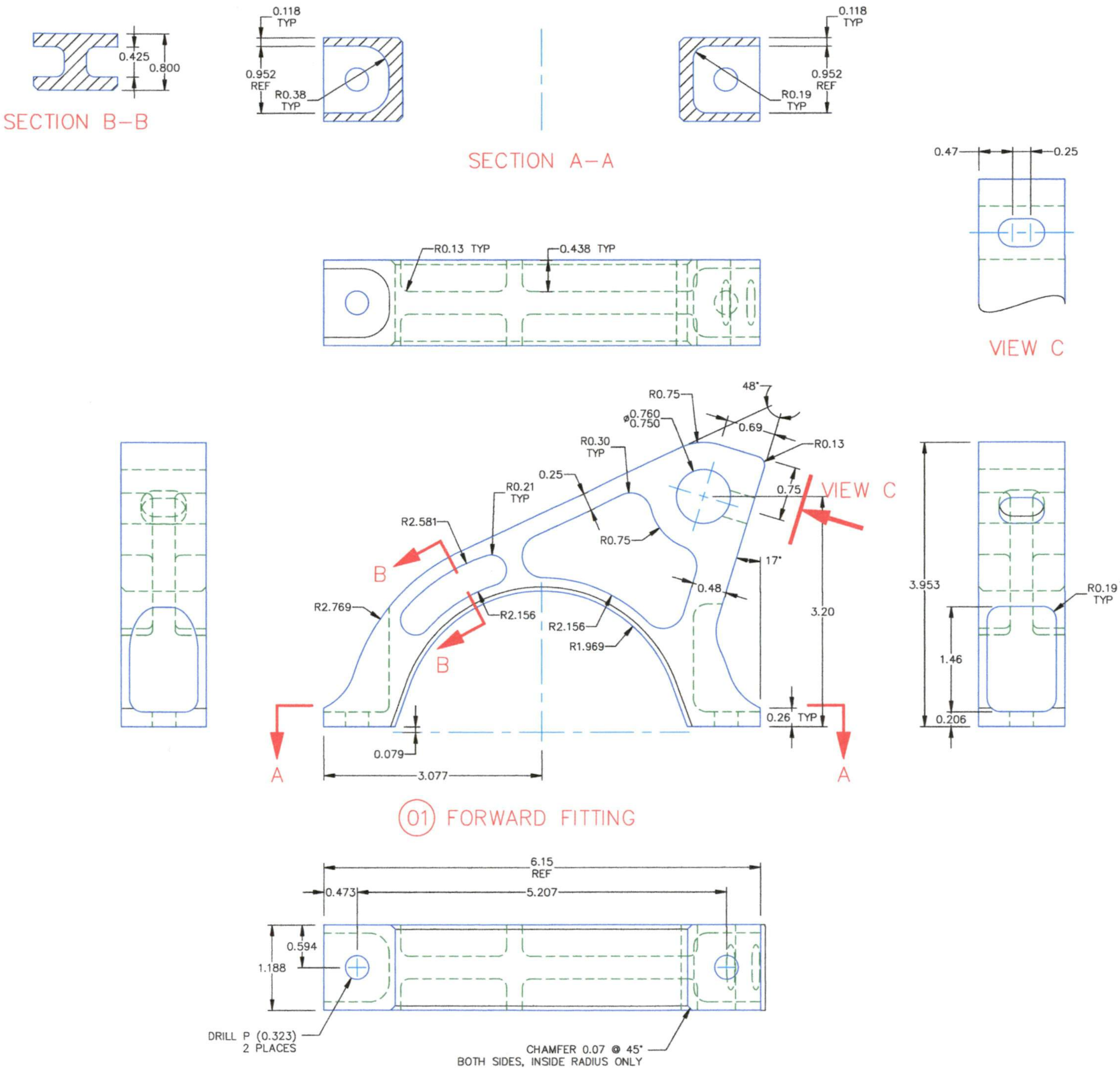


Figure 6.0.2 – Forward Fitting (reference drawing 100930)

The slight reduction is section on the RH portion of section A-A is acceptable as the tensile strength of the strap is significantly greater than can be supported by the fastener (see section 5.6), and the material of the new part has higher tensile strength than the original.

6.1 FAR 27.471 – Ground Loads – General

(a) Loads and equilibrium. For limit ground loads—

(1) The limit ground loads obtained in the landing conditions in this part must be considered to be external loads that would occur in the rotorcraft structure if it were acting as a rigid body; and

(2) In each specified landing condition, the external loads must be placed in equilibrium with linear and angular inertia loads in a rational or conservative manner.

See rationale in Section 6.3.

(b) Critical centers of gravity. The critical centers of gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element.

No change from Type Approved configuration.

6.2 FAR 27.473 – Ground Loading Conditions and Assumtions

(a) For specified landing conditions, a design maximum weight must be used that is not less than the maximum weight. A rotor lift may be assumed to act through the center of gravity throughout the landing impact. This lift may not exceed two-thirds of the design maximum weight.

(b) Unless otherwise prescribed, for each specified landing condition, the rotorcraft must be designed for a limit load factor of not less than the limit inertia load factor substantiated under Sec. 27.725.

See rationale in Section 6.3.

6.3 FAR 27.501 – Ground loading conditions: landing gear with skids

The ground load conditions specified in FAR 27.501 are vertical loads in combination with fore/aft or lateral loads. There is no change from the Type Approved configuration for demonstration of compliance for any upward loads as the strap does not support upward loads. The comparison above shows the new fitting is stronger than the original, therefore there is no change from the Type Approved configuration for demonstration of compliance for downward loads applied to the strap. The new fitting is identical in the inside radius where the cross tube is clamped up with the original rubber pad, therefore there is no change from the Type Approved configuration for demonstration of compliance for lateral or fore/aft loads.

6.4 FAR 27.549 – Fuselage, landing gear, and rotor pylon structures

FAR 27.549(b) specifies the applicable load conditions that the landing gear must be designed to withstand:

> *(b) Each structure must be designed to withstand—*
>
> *(1) The critical loads prescribed in Secs. 27.337 through 27.341;*

(2) The applicable ground loads prescribed in Secs. 27.235, 27.471 through 27.485, 27.493, 27.497, 27.501, 27.505, and 27.521; and

(3) The loads prescribed in Sec. 27.547 (d)(2) and (e).

FAR 27.337 through 27.341 are maneuvering and gust load conditions, loads in the vertical direction. The critical load on the forward attachment straps is the ultimate positive maneuvering condition. Gust loading is primarily applied to the aft attachment due to the large fairings on the aft cross tubes. The comparison of the original strap to the new fitting above shows the strength of the new fitting exceeds the original. The maneuvering condition is included in the analysis in section 5.6.1.

FAR 27.235 and 27.475 thru .497 do not apply as the EC130 does not have wheeled landing gear. FAR 27.505 and 27.521 do not apply as the EC130 is not equipped with ski or float type landing gear respectively. FAR 27.547 does not apply to the landing gear.

6.5 FAR 27.571 – Fatigue

Only the forward landing gear straps are considered with respect to fatigue.

Drag (Longitudinal) Condition

Drag is applied once per flight when the helicopter reaches cruise speed.

$$P_{x\_max} := P_{drag\_lim}$$

$$P_{x\_max} = 340\text{lbf}$$ Maximum longitudinal load (X direction), at cruise

$$P_{x\_min} := 0 \cdot \text{lbf}$$ Minimum longitudinal load, on ground

$$R_x := \frac{P_{x\_min}}{P_{x\_max}}$$

$$R_x = 0$$ Stress ratio for longitudinal load cycle

$$N_x := 1 \cdot \frac{\text{cycle}}{\text{flight}}$$ Frequency of longitudinal load cycle

Maneuvering (Vertical) Condition

The weight of the installed equipment and provisions (1g) is applied to the attachment fittings at all times. A typical flight is assumed to apply one acceleration to +2.5g and one to -0.5g. Excursions beyond these accelerations are expected to occur on a limited number of occasions, but not enough to be significant to the life of the provisions.

$n_{man} = 2.5$ Maximum maneuvering load factor (Z direction)

$n_{man\_neg} = -0.5$ Minimum maneuvering load factor

$$R_z := \frac{n_{man\_neg}}{n_{man}}$$

$R_z = -0.2$ Stress ratio for vertical load cycle

$N_z := 1 \cdot \frac{cycle}{flight}$ Frequency of vertical load cycle

Fasteners

The critical fastener at point T from section 5.6.1 is considered. Using the analysis performed in section 5.6.1, using 2.5 vertical load factor and limit drag:

$$R_{T\_t} := \frac{R_{Cx} \cdot 4.49 \cdot in + R_{Cz} \cdot 4.43 \cdot in + P_{lim\_man\_pos\_LG\_fitting} \cdot 2.51 \cdot in - P_{lift\_LG} \cdot 2.51 \cdot in + P_{drag\_LG} \cdot 0.69 \cdot in}{5.21 \cdot in}$$

$$R_{T\_t} = \frac{304.478 \cdot lbf \cdot 4.49 \cdot in + 1509.548 \cdot lbf \cdot 4.43 \cdot in + 77.13 \cdot lbf \cdot 2.51 \cdot in - 23.6 \cdot lbf \cdot 2.51 \cdot in + 35.45 \cdot lbf \cdot 0.69 \cdot in}{5.21 \cdot in}$$

$R_{T\_t} = 1576 \cdot lbf$ Tensile reaction at T

The shear load is minimal and is not included. Preload tension on bolt due to specified torque:

$T_q := 23 \cdot m \cdot N$ Bolt tightening torque (ref: Eurocopter Standard Practices Manual Section 20.02.05.404)

$K := 0.16$ Correction factor - cadmium plated fastener

$d := 8 \cdot mm$ Bolt diameter

$$F_i := \frac{T_q}{K \cdot d}$$

$F_i = 17969\ N = 4040\ lbf$ Preload on fastener due to torque

The applied load does not exceed the preload. The tension in the bolt is therefore static and fatigue does not apply, reference Analysis and Design of Flight Vehicle Structures by Bruhn, section C13.5.6.

Strap Fitting

The drag and maneuvering conditions act simultaneously, producing the loads on the bolt at T. The critical section of the strap fitting is through Section A-A on Figure 6.0.2.

$R_{T\_t} = 1576 lbf$ Tension on bolt applied in vertical load cycle (2.5g) applied to Section A-A

$K_t = 3.3$ Stress concentration factor for notched section

$A_{AA} := 0.459 \cdot in^2$ Area through Section A-A (right side only)

$$s_{max} := \left(\frac{R_{T\_t}}{A_{AA}}\right) \cdot K_t$$

$s_{max} = 11334 psi$ Maximum tensile stress on section A-A

$$s_{eq} := s_{max} \cdot (1 - R_z)^{0.62}$$

$s_{eq} = 12690 psi$ Equivalent stress on section A-A
reference AR-MMPS-01, Figure 3.7.6.1.8(a)

$R_z = -0.2$ Stress ratio for vertical direction

$$N_{fail} := 10^{18.22 - 7.77 \log(s_{eq} - 10.15)}$$

$N_{fail} = 1.2 \times 10^{15}$ Cycles to failure
reference AR-MMPS-01, Figure 3.7.6.1.8(a)

The number of cycles to failure is extremely high, exceeding the expected life of the helicopter.

7.0 COMPLIANCE WITH FAR 27.725, .725 - LIMIT DROP TEST / RESERVE ENERGY DROP TEST

The height of the cargo swing assembly is used to determine the allowable clearance to comply with the drop test requirements. The cargo swing frame assembly and hook are 11 inches high, not including the suspension lines, and is considered to be pushed up against the bottom of the fuselage. The lowest part of the basket is 11.75 inches below the bottom of the fuselage.

Advisory Circular AC27-1B 27.727A, section b. (2):

> *External accessories that may not impact the level landing surface during drop testing (or equivalent gear deflections) include devices such as externally mounted fuel tanks or accessories likely to cause post-landing fires. Expendable accessories, such as cameras, loudspeakers, and search lights, may be damaged during landing gear deformations resulting from reserve energy drop tests if electrical connections are sufficiently protected to preclude electrical fires and the devices are not likely to penetrate a fuel compartment or occupied areas. The expendable accessories, if installed, should also be designed to not have "hard points" that would unacceptably damage the rotorcraft structure under landing impacts by penetration into the occupied*

areas or fuel tanks. Design features may be employed to preclude this penetration if possibly hazardous. The expendable accessories, if installed, should be designed with frangible fittings, frangible devices, or comparable design features. Also, these devices should be designed to not significantly alter the energy absorbing ability or design features of the landing gear.

This installation does not include any items which could cause or contribute to a post landing fire.

This installation does not include any hard points that could penetrate the occupied areas.

The mounting beams themselves do not extend below the envelope established above. The aft mounting beam is located under the fuel tank. In the event that the basket was to contact the ground, for the limited distance to reach the required minimum clearance, the basket will deform and the mounting beams will deflect. In the unlikely event that the aft mounting beam attachments were to fail, the mounting beam would contact the main longitudinal beams of the airframe before contacting the fuel tank.

There is approximately 3 inches of clearance (perpendicular from cross tube to basket) over the forward cross tube. The basket does not cross the aft cross tube. The area of the basket over the cross tube is expanded metal mesh, with the frames located beyond the cross tube. Deflection of the landing gear sufficient to allow the cross tube to contact the basket will push the cross tube into the mesh, deforming the mesh around the cross tube. The concentrated contact area of the cross tube with the mesh will not require much force to deform the mesh, on the order of a hundred pounds, and therefore will not significantly alter the energy absorbing ability of the landing gear.

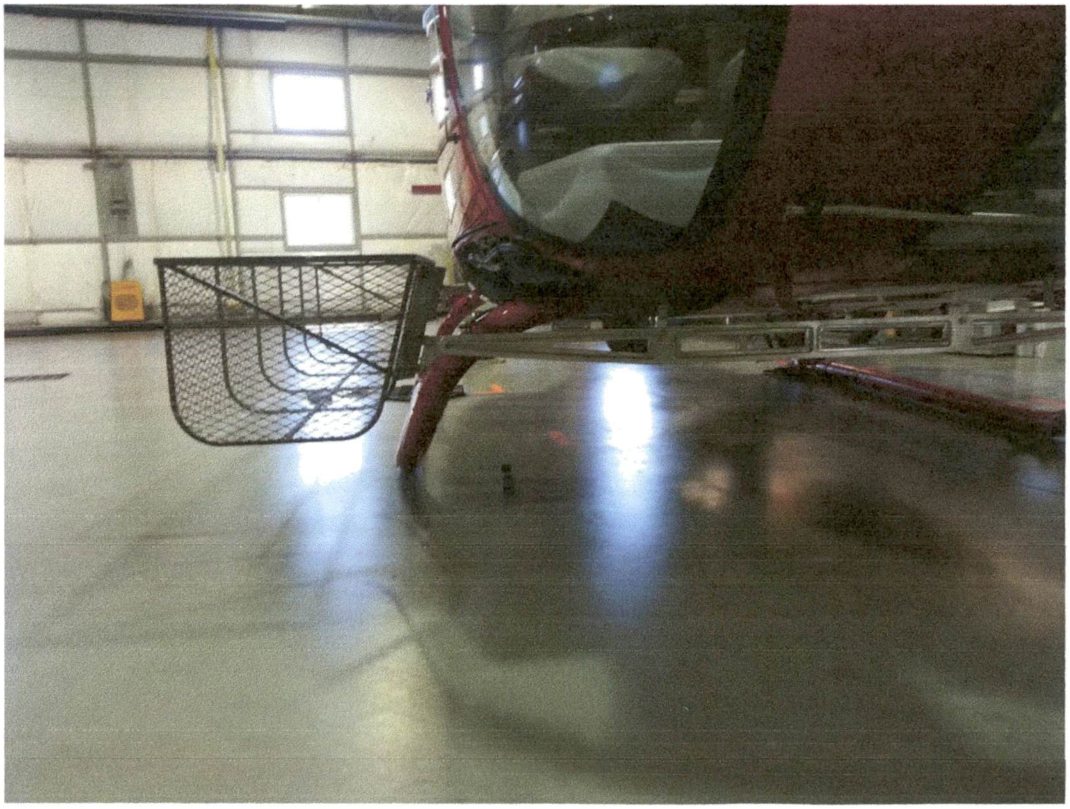


Figure 7.0.1 – Cargo Basket Installation, Looking Aft

Figure 7.0.1 – Cargo Basket Installation, Looking Inboard

8.0 COMPLIANCE WITH FAR 27.783 – DOORS

(a) Each closed cabin must have at least one adequate and easily accessible external door.

No change from Type Approved configuration.

The basket is located below the doors, and is low enough to allow all doors to open fully.

(b) Each external door must be located where persons using it will not be endangered by the rotors, propellers, engine intakes, and exhausts when appropriate operating procedures are used. If opening procedures are required, they must be marked inside, on or adjacent to the door opening device.

No change from Type Approved configuration.

9.0 COMPLIANCE WITH FAR 27.807 – EMERGENCY EXITS

(a) Number and location. Rotorcraft with closed cabins must have at least one emergency exit on the opposite side of the cabin from the main door.

No change from Type Approved configuration.

(b) Type and operation. Each emergency exit prescribed in paragraph (a) of this section must—

(1) Consist of a movable window or panel, or additional external door, providing an unobstructed opening that will admit a 19- by 26-inch ellipse;

No change from Type Approved configuration. Doors are jettisonable.

(2) Be readily accessible, require no exceptional agility of a person using it, and be located so as to allow ready use, without crowding, in any probable attitudes that may result from a crash;

No change from Type Approved configuration.

(3) Have a simple and obvious method of opening and be arranged and marked so as to be readily located and operated, even in darkness; and

No change from Type Approved configuration.

(4) Be reasonably protected from jamming by fuselage deformation.

No change from Type Approved configuration.

(c) Tests. The proper functioning of each emergency exit must be shown by test.

No change from Type Approved configuration.

(d) Ditching emergency exits for passengers.

Not applicable.

10.0 COMPLIANCE WITH FAR 27.952 – FUEL SYSTEM CRASH RESISTANCE

The EC130B4 is exempt from 27.952 (a), (c), (d), (f), and (g).

(b) *Fuel tank load factors.* No change from Type Approved configuration. This installation does not change the load factors applied to the fuel tank.

(e) *Separation of fuel and ignition sources.* No change from Type Approved configuration.

11.0 COMPLIANCE WITH FAR 27.1387, .1401 – LIGHTS

The external lighting system consists of (see figure 7.0.1):

Landing and taxi lights on the bottom fairings (1 and 6);

Position lights at the ends of the horizontal stabilizer (2, 5);

Position light on top of the fin (4);

Anticollision light on the fin fairing (3).

Installation of the mounting provisions and cargo basket does not block these lights.

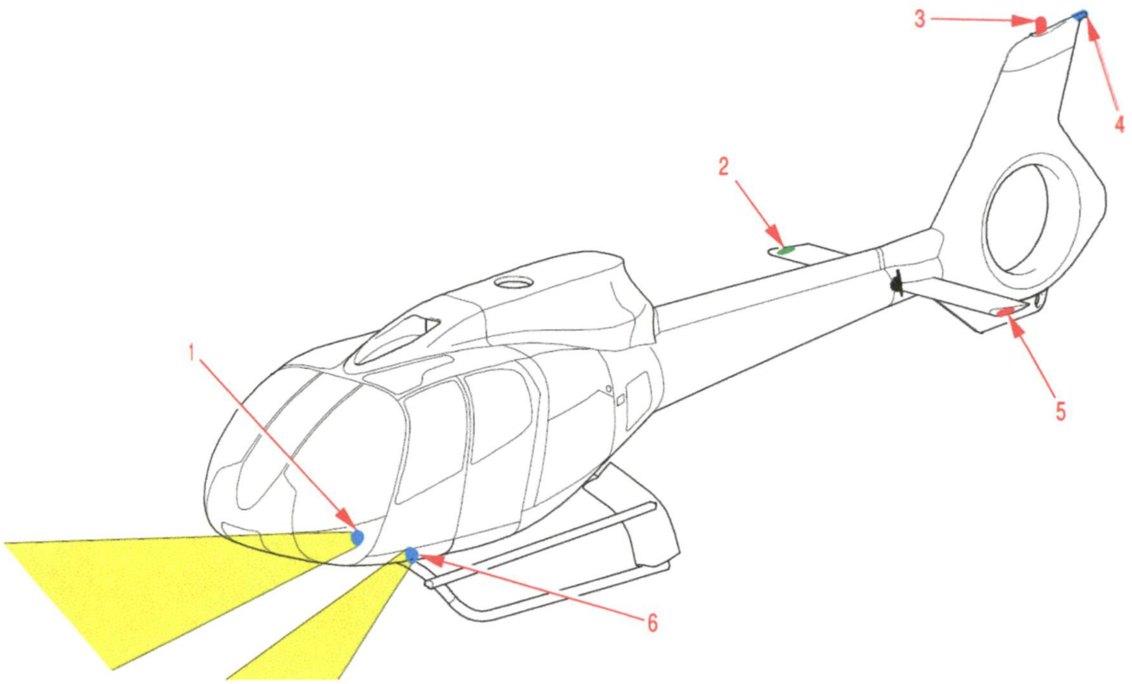


Figure 7.0.1 – External Lighting Locations

APPENDIX A

EMAIL FROM AIRBUS HELICOPTERS

REGARDING STRAP FITTING MATERIAL

From: Creally, Jarrod [mailto:Jarrod.Creally@airbus.com]
Sent: March 30, 2015 11:09 AM
To: Jeff Clarke
Subject: RE: EC130 Loads?

Hi Jeff,

I was able to get the material of the clamp from the drawings, looks to be made out of 7175 Aluminum.

Haven't heard back from France yet about the allowable loads available for the landing gear attachment points, but I will follow up.

1ère LIGNE : DÉNOMINATION 2e LIGNE : DÉNOMINATION MATIÈRE
COLLIER TOLE 7175

Regards,
Jarrod

Please note my new email address: jarrod.creally@airbus.com

AIRBUS HELICOPTERS

Jarrod Creally
Technical Support Representative
(British Columbia)
Airbus Helicopters Canada Limited
Tel: 1 (778) 475-1899
Cell: 1 (250) 307-6408
jarrod.creally@airbus.com

Note – French translations

Collier – collar (the strap is noted as "collar" in some sections of maintenance manual)

Tole (tôle) – sheet metal

Wings Engineering Limited Project No.; WPN1507

Certification Plan Review, AD1009-CP.Review-NC-26Jun2015

Aero Design Project Number 1009
Revision to STC SH08-16
Add Mounting Provisions (for Basket/Step/Bike Rack/s), Extra Large Basket and Step to suit the EC130B4

Documents Reviewed

CertPlan_CP1009_1-09June2015.pdf

Cover Page

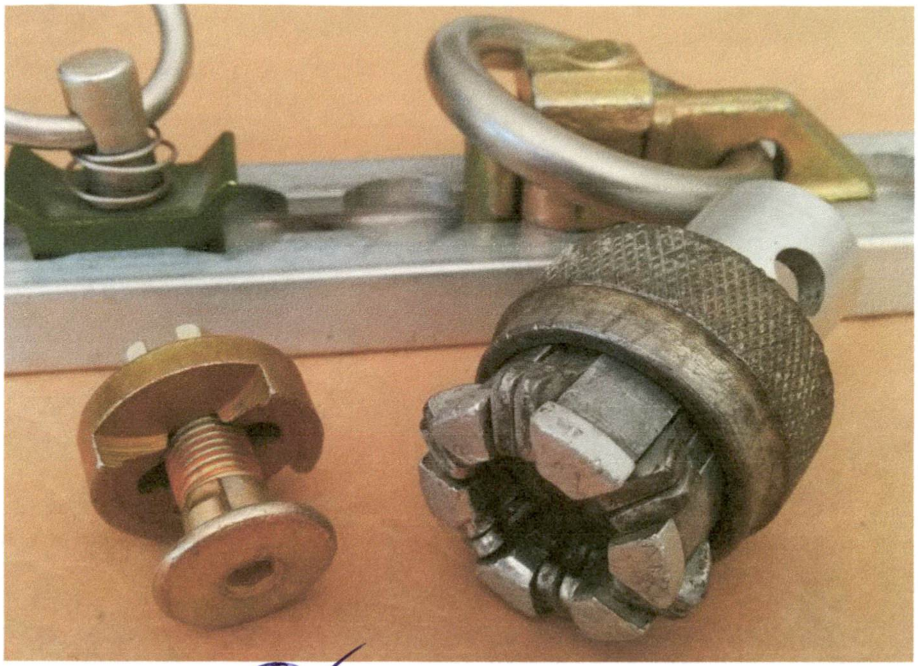
Change to read "EC130 B4" ✓

4.2, 2nd Paragraph need to be clearer and there needs to be some additional qualification of the material substitution and design changes. i.e.; replace with:

"The original Airbus billet machined 7175-TXXX Forward Cross Tube Clamps are replaced with Aero Design billet machined 7075-TXXX Clamps. These replacement clamps include integral lugs to accommodate barrel nuts in order to provide hard points for the attachment of the Fwd Beam. These hard point provisions are identical to the Aero Design hard point provisions for the Bell 206L/407 Cargo Baskets. See ER1009 for the applicable fatigue/ strength /dimensional /protection /hardware /service qualification analysis for these replacement clamps." ✓

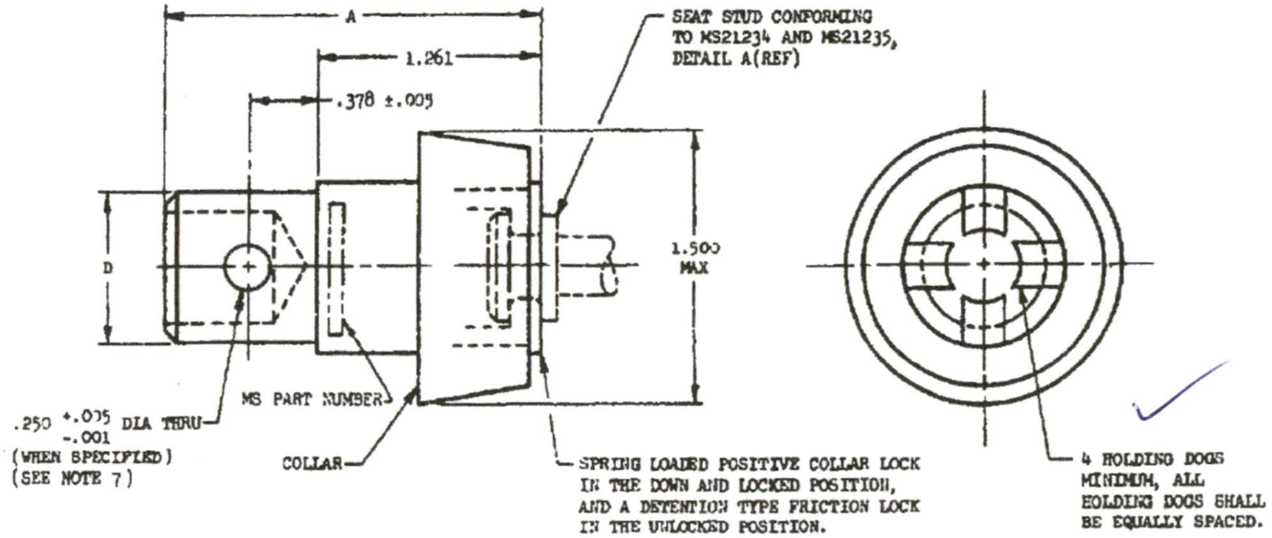
4.2, Pg 7, Paragraph need clarification and qualification

The aft attachment picks up on the main fuselage frames at the aft fuel cell cross member (figure 4.2.3, "A"). The aft fuel cell cross member includes the aft attachment points for the cargo swing (2557 lbs slung load), ~~which can be~~ is ✓ used to calculate the allowable loads on the frame per ERXXX. ✓ In order to install the lower aft fuselage fairing panel, which slides between the fuselage frames and landing gear fairings with little room to rotate, the aft attachment fittings cannot extend lower than the fairing panel once installed. To simplify installation and reduce the required cutout size in the fairing panel, the fitting incorporates a 5000lb ? ✓ seat ~~track type~~ stud fitting, the same as the basket attachments. The mounting beam attaches to the fitting with a 5000lb ? ✓ seat stud ~~type~~ quick disconnect ✓ claw fitting (see figure 4.2.4)~~, the same as used with the Aero Design Rappel and Cargo Deployment System~~. The claw fitting is secured ~~with a~~ via an integral locking ring feature. ✓ ~~also used with the Rappel and Cargo Deployment System, to prevent inadvertent release.~~



The Standard Seat Track Stud Does Not Fit This Bell 212 Seat Claw Fitting
AD drawings note Ancra Seat Stud type Passenger Seat Fittings
as shown below

MS22034, Adapter, Quick Disconnect, Passenger Seat to Floor (Claw Fitting)



4.3, First Paragraph, Get to the relative basket changes quicker

~~The extra large Quick Release Cargo Basket developed by Aero Design Ltd. for the AS350 is the right size for operators using the EC130 for heli-ski, tourism, and utility contracts.~~ The only difference between the existing AS350 extra large basket (model 940) and the EC130 extra large basket (model 1009) is the attachment points are moved to the first and last hoops, which is the same configuration as the AS350 medium and short baskets (model 764 and 776). All other construction of the basket remains the same as basket model 940. The 300 lb (136 kg) cargo load limit also remains the same.

Figure 4.3.1 - Model 1009 Quick Release Cargo Basket ✓

4.4 How do you know that the step is required?

Please quote requirement. Part of TCDS? Customer demand? etc.

↳ Believe so, SB 32-002 shows upgrade "series production foot step"

Figure 4.4.1 - Model 1010 Quick Release Cabin Step ✓

4.5 Table

Re-title Columns 2 & 3; Max Cargo, Installed Wt ✓

Are there options for Left/Right/Both sides basket installs? Config #'s? Yes ↳ provided

Same questions for the Step/s. - yes provided

Include W&B info for original step to complete the comparison?

don't have weight now

5.0 Basis of Certification

Rework this section to obtain TCCA's acceptance to use the FAA's TCDS FAR 27 requirements. i.e.; the special TCCA conditions are not applicable? and/or other justification.

5.2.1 FAA - TCDS H9EU, Revision 23

[I have noted that the FAA's TCDSs are typically more clearly written than TCCA's.]

Data Pertinent to all Models Except EC130B4 & T2

N/A to EC130

1009 EC130 only

Page 16, Certification Basis;

14 CFR 21.29 and part 27 effective February 1, 1965 plus Amendments 27-1 through 27-10, plus FAA Special Conditions No. 27-79-EU-23, dated August 13, 1977.

27.571 Fatigue evaluation of flight structure at Amdt 27-3 needs to be addressed:

(a) General. Each portion of the flight structure (including rotors, controls, fuselage, and their related primary attachments)...

Not a typical requirement for cargo pods/baskets.

Page 17, 2nd Paragraph from top

For A/C incorporating mod. OP3369 (2370 kg/5225 lb mass extension) the following 14 CFR part 27 Amendments 27-1 through 27-40, are replacing the same requirement from the certification basis above : ... §571; .

→ For bike rack, not exceeding loads established for cargo basket

27.571 Fatigue evaluation of flight structure at Amdt 27-26 needs to be addressed:

(a) [General. Each portion of the flight structure (the flight structure includes rotors, rotor drive systems between the engines and the rotor hubs, controls, fuselage, landing gear, and their related primary attachments), ...]

Needs to be discussed with Wings/AD prior to discussions with TCCA.

Pg 17, EC 130B4 Certification Basis;

14 CFR 21.29 and part 27 Amendment 27-1 through Amendment 27-32 except 14 CFR 27.952 is not adopted.

Again 27.571 at Amdt 27-26 needs to be addressed

Needs to be discussed with Wings/AD prior to discussions with TCCA.

5.3 This Modification

Remove AC 521-004 and add SI 512-004 and 005 ✓

7.3 27.45, .51, .65, .71, .73, .75, .141, .143, .171, .173, .175, .177, .241, .251 – Flight Requirements and .547 – Main rotor structure (Mast Bending) ✓

7.3.2, b,

Can you please provide an expanded description for the VXP analyzer and plans? i.e.; Honeywell? VXP model number XXX, display, data bucket, using XXX sensor/pick-ups, owner/operators' manual number, used by Airbus ??, pick-up locations iaw ??? Etc. and/or
Note that the applicable test procedure will detail the extent of the VA pass/fail plans which will include running a baseline spectrum for comparison?

Notes for Airbus spectrum/limits/locations? ✓

7.5 27.471, .473, .501, .549, .571 – Strength Requirements (Landing Gear)

7.5.2, b) add The report addresses the applicable fatigue/ strength /dimensional /protection /hardware /service qualification analysis for these replacement clamps. ✓

7.5.5, a) add .571 ✓

7.8 Please work in a comment and a check in the FTP to evaluate egress. ✓

↳ added to FTP section 3

7.9 Please work in a note as 7.10 that Aero Design does not use the 27.865 design requirements because of the no-passenger restrictions wrt to FAA Part 133 RLC Class A per therefore the baskets are designed to baggage compartment "requirements". ✓

Appendix A

27.307 Analysis

- per ER1009? Please include the applicable report number for all analysis references. ✓

27.561(c), "Side mounted bike rack/s are not located...."

- Please add a report reference where the report needs to explain how/why a deflected basket will not impede egress or penetrate the cabin. ✓

27.571 Please add with FOC by DOT ✓

27.807 Statement in report

- add report number ✓

28.865 Add and then reference the earlier statement wrt RCL Class A. ✓

Drawings

100916_0_2015-05-21.pdf, QR Mnt Provisions, Aft Beam Assy

- Why is item 7 noted "DO NOT FULLY TIGHTEN"? Needs to be aligned to air frame
  What is not fully tightened? Claw fitting
  How is it locked? Via Self-Locking Barrel-Nut? Yes

NDT Requirements should be noted on drawings. NO CRACKS ALLOWED

- Welding 10x's visual?
- Machined Aluminum (and non-ferrous); FPI iaw ASTM E 1417
- Machined Steel; MPI iaw ASTM E 1444

Anodizing must be carefully spec'd for parts subject to fatigue see Mil-A-8625F

6.6.1 ... Where anodic coatings are required on fatigue critical components, Type I and IB coatings (see 6.1.2) are used due to the thinness of the coating (see 6.10.7).

6.1.2 Type IC and IIB. Type IC and IIB coatings provide non-chromate alternatives to Type I and IB coatings where corrosion resistance, paint adhesion, and fatigue resistance is required.

- Process sensitive therefore an approved plating shop must be used.
- US.Army_A108869_The.Effect.of.Surface.Coatings.on.the.Fatigue.Strength.of.Aluminum.Alloys. Table 2. 7075-T6
  - 80% reduction without shot peening
  - Large improvements with shot peening

ER1009.01_0_2015-06-03.pdf, Mounting Provisions and (XL) Cargo Basket

3.0 Basis of Certification

- reference CP's BoC or copy the FA27 BoC from the CP. ✓

MathCAD General Request

- Please add a second step to all calcs to show values used.

Figure 5.6.1

- Show beam limit/ultimate P values on FBD to show balanced loading ✓
- Please increase the FBD font sizes to 8Pt min. ✓

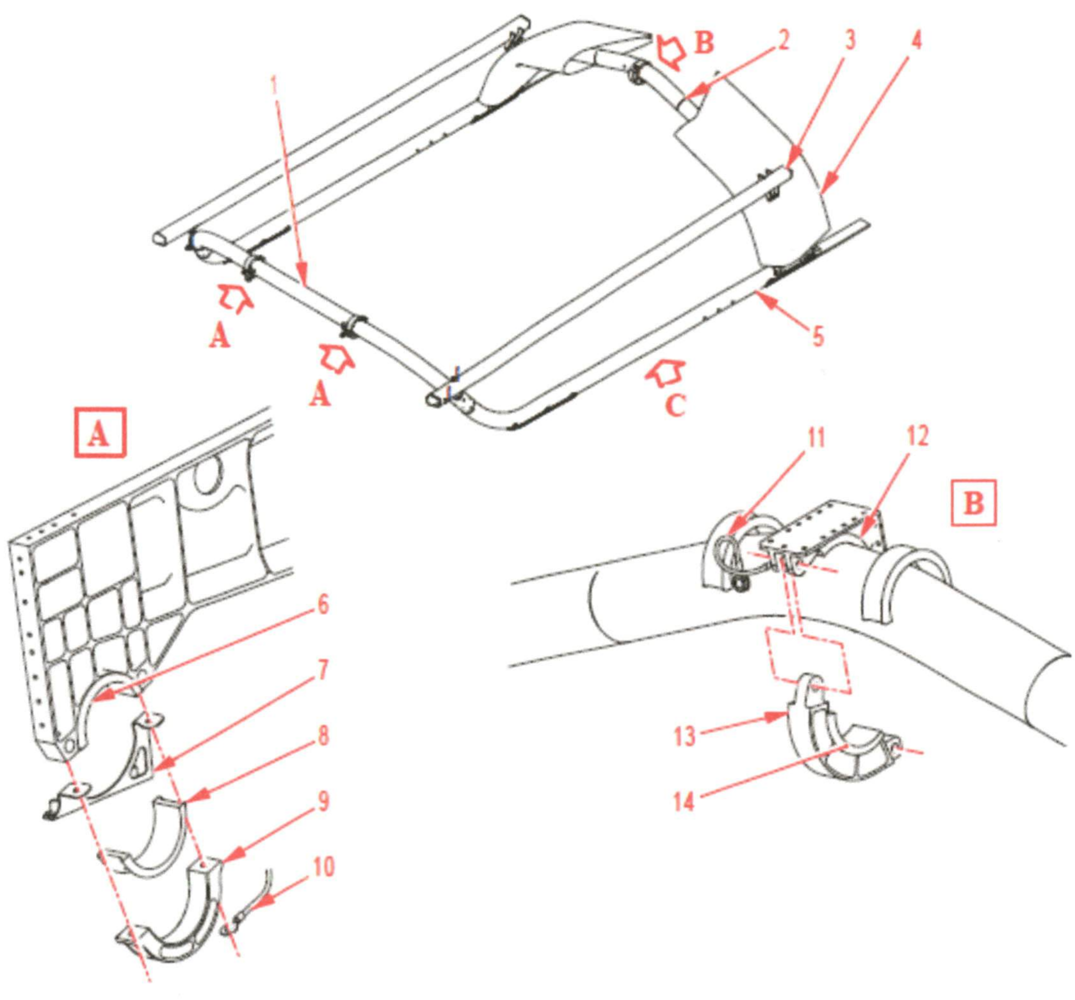
Figure 5.6.3

- See red-lined figure. 3/3 last page. ✓

5.6.1 Fwd Attachment

- Please include an Airbus figure to show the 3 attachment points. SDS 32-11-00, 03? ✓

Figure 1. Main Landing Gear - Detailed Description



✓

- The small inertia loads from the gear weight should be insignificant wrt the asymmetric landing loads? Basket loads included in landing loads?
- Noting that the structural strength is limited by the M8 bolts is good. ✓
- Include moment arms dimensions for the Rt calcs strap on Figure 5.6.4 now 5.6.5
- wrt Rt calc, Aren't there x and z components for Pman? X being drag on gear?

- Please call to explain the shear/tension calcs at the top of page 16. ↳ 42 lbs @ Vd +28 lbs lift negligible?
- MS M8 bolt = 8590 / 2454 / 1.15 ff - 1 = 2.0 ✓
- WRT Fwd Clamps Airbus vs. Aero Design needs to be address wrt fatigue/ strength /dimensional /protection /hardware /service / etc.
  PAINT Reused ↳ICA
- Figure 5.6.6 Does the EC130 SRM call out the Long Beam material? NO
  5052-O is just too far out an assumption for a keel beam.
  i.e.; 6061-T6 would still be conservative for a heavy beam. ← ✓
- Top of page 18.
  Provide an MS for this evaluation. ✓ Now page 22

5.6.2 Aft Attachment

- The 2557 Lb "Swing" Cargo Hook System has reinforced cradles iaw SB25-032. ✓
- The 1009 system mounts on the aft cradle? No
  Can you confirm that this cradle is as strong fwd/vertically as required? Not mounted to cradle
  i.e.; is it braced like the fwd cradle? No
  I have a 2009 EC130 Disk and there are no IPC pages or SRM pages for the cabin floor structure or the mid-structure.
- Figure 5.6.7 is for the 1653 Lb "Sling" Cargo Hook attachment provision on the fwd cradle = stronger than the Swing's 2557/4 assumption. Shifting attachment forward not feasible, overhang too long on basket
- arc tan (Pdrag_ult 510 Lbs / Pman_ult 1969 Lbs) = 14.5° from vertical
  Please chech calc shown and show parameters and values.
- Show MS's for vert and horz comparisons. ✓

14.5° does not work for 865 loads

5.7 Dual Basket Installation

- Add Beam Ult wt to Balance FBDs and rework moments as required. ✓

11.3 - 13.6

drag MS=0 vert MS=0

6.0 Compliance with - Landing Gear add 571

- Expand review as noted earlier.

7.0 Doors to 10.0 Light = All good for now ✓

725/727 added

ER1010.01_0_2015-05-23.pdf, Cabin Step

All good for now. ✓

FTP1009.03_0_2015-06-04.pdf, (XL) Cargo Basket

3.0 Add egress evaluation of Basket and Step. ✓

- Single Basket configurations will have a Step installed? Yes

4.4 Documents

- Flight Authority (Flight Test Permit), Attach copy. ✓
- W&B Report, Attach copy. ✓
- Conformity Inspection, Attach copy of Applicant's AN B043 CIR ✓
- Statement of Suitability for Flight Test, Attach copy of SI 521-004, Table F-1 ✓
- Flight Test Safety Checklist, Attach copy of SI 521-004, Table F-2 ✓

5.1 Test to 1.11Vne? What is the Vne for the AS350 Cargo Basket?

DART = 108 KTS Full A/C Vne → Attach FMS

TR1009.02_0_2015-05-20.pdf, Load Tests, Mounting Provisions and (XL) Cargo Basket

2.0 Are you using AD barrel nuts or Airbus M8 barrel nuts for the beam attachment hardware? Thread directly into fixture w/ AN5 bolts

4.2 Test Fixture

- The steel posts are going to be bolted to the floor? Yes, and braced

4.3.1 Combined Load

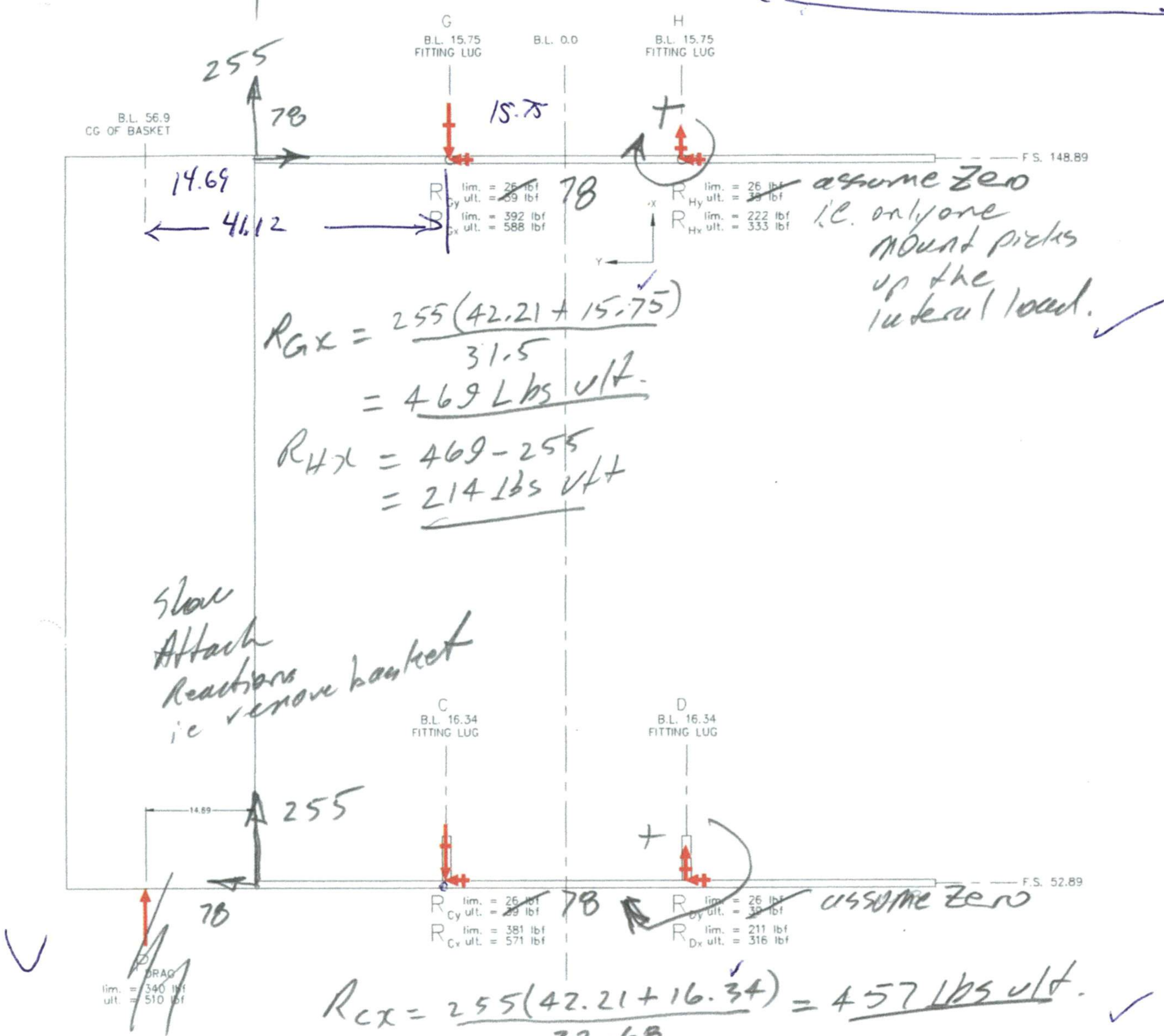
- Given that the Basket is mounted on the ends pulling from the fwd or the aft frame will provide the same loading into the test structure.

Yes, but horizontal keyways open forward

Red-Lined ER1009.01_0 Figure 5.6.3

BL 42.21 ← not 41.12 ?

$41.12 + 15.75 - 14.69 = 42.2$



$$R_{Gx} = \frac{255(42.21 + 15.75)}{31.5} = 469 \text{ Lbs ult.}$$

$$R_{Hx} = 469 - 255 = 214 \text{ lbs ult}$$

$$R_{Cx} = \frac{255(42.21 + 16.34)}{32.68} = 457 \text{ lbs ult.}$$

$$R_{Dx} = 457 - 255 = 202 \text{ lbs ult}$$

Figure 5.6.3 – Helicopter Reactions, Drag Load

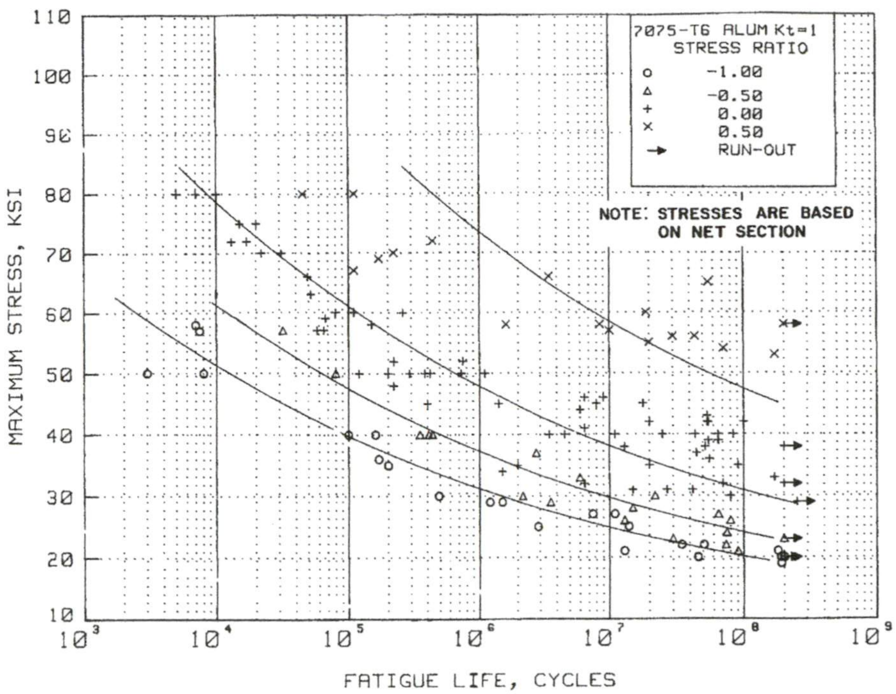


Figure 3.7.6.1.8(a). Best-fit S/N curves for unnotched 7075-T6 aluminum alloy, various product forms, longitudinal direction.

Correlative Information for Figure 3.7.6.1.8(a)

Product Form: 0.75 inch diam. drawn rod, 1.25 inch diam. rolled rod, and 1 x 7.5 inch bar, extruded 1.25 inch bar and 1.25 inch rod

Properties:

TUS, ksi	TYS, ksi	Temp., °F
82	72	RT

Specimen Details: Unnotched
Minimum diameter 0.200 inch

Surface Condition: Unspecified

Reference: 3.7.6.1.8

Test Parameters:
Loading - Axial
Frequency - 30 Hz
Temperature - RT
Environment - Air

No. of Heats/Lots: 8

Equivalent Stress Equation:
Log N_f = 18.22-7.77 log (S_{eq}-10.15)
$S_{eq} = S_{max} (1-R)^{0.62}$
Std. Error of Estimate, Log (Life) = 0.626
Standard Deviation, Log (Life) = 1.435
R^2 = 81%

Sample Size = 130

[Caution: The equivalent stress model may provide unrealistic life predictions for stress ratios beyond those represented above.]

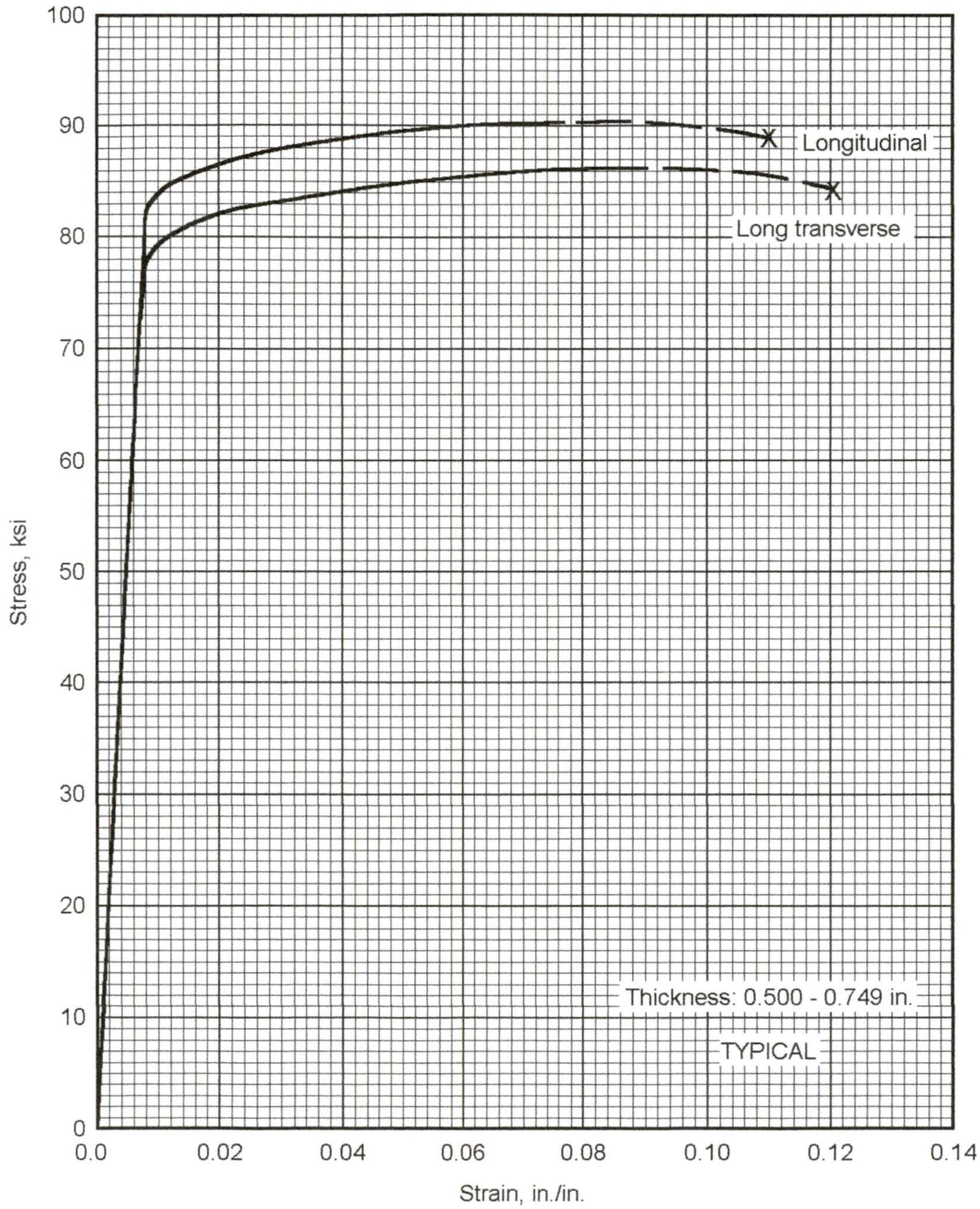


Figure 3.7.6.1.6(p). Typical tensile stress-strain curves (full range) for 7075-T651X aluminum alloy extrusion at room temperature.

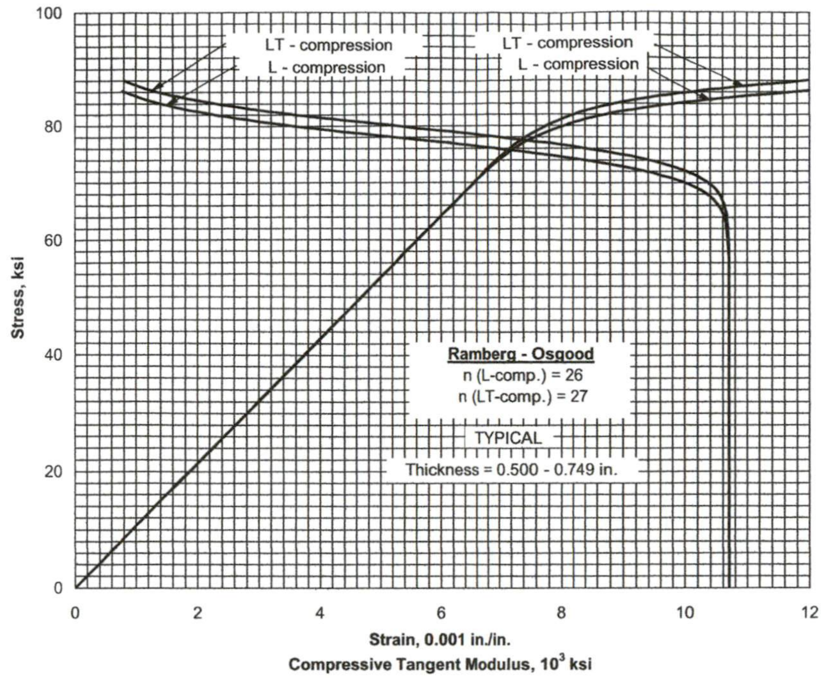


Figure 3.7.6.1.6(l). Typical compressive stress-strain and compressive tangent-modulus curve for 7075-T651X aluminum alloy extrusion at room temperature.

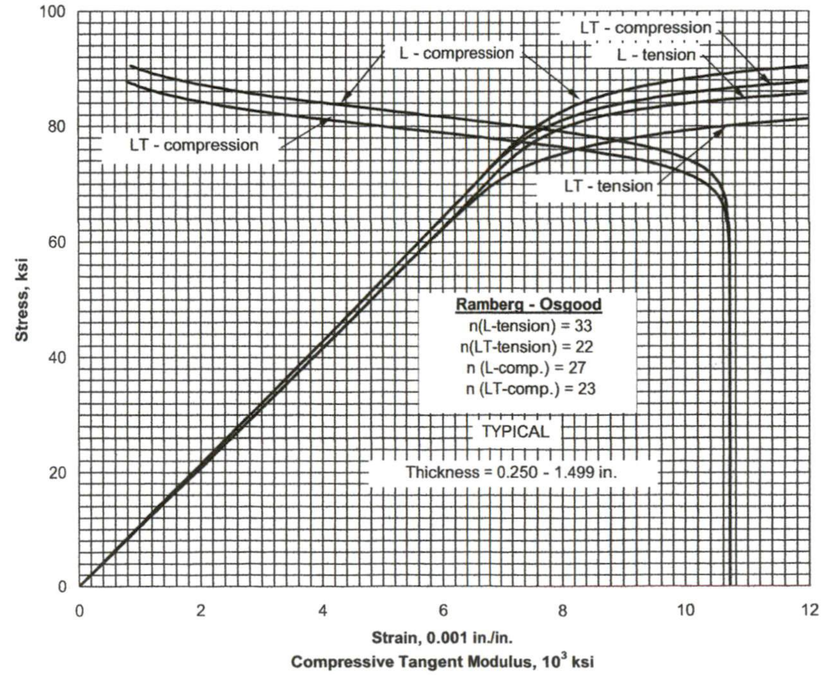


Figure 3.7.6.1.6(m). Typical tensile and compressive stress-strain and compressive tangent-modulus curves for 7075-T62 aluminum alloy extrusion at room temperature.

525	625	Fitting factors.	
		Personnel And Cargo Accommodations	
525	785	Seats, berths, safety belts, and harnesses.	
		SUBCHAPTER G – Operating Limitations and Information	
525	1529	Instructions for continued airworthiness	
		Markings and Placards	
525	1557	Miscellaneous markings and placards	
		End of AWM 525	

AWM 527, Normal Category Rotorcraft

CHAPTER	REQUIREMENT	PARAGRAPH TITLE	EXCEPTIONS
		SUBCHAPTER A - GENERAL	
527	1	Applicability.	
527	2	Special Retroactive Requirements	
		SUBCHAPTER B – FLIGHT – GENERAL	
527	29	Empty weight and corresponding center of gravity.	
		SUBCHAPTER C - STRENGTH REQUIREMENTS - GENERAL	
527	303	Factor of safety.	
527	305(a)(b)(1)	Strength and deformation.	
527	307(a)(b)(2)	Proof of structure	
		Flight Loads	
527	337 (a)	Limit manoeuvering load factor	
		Control Surface and System Loads	
527	397	Limit pilot forces and torques.	
		Emergency Landing Conditions	
527	561	General	
		SUBCHAPTER D - DESIGN AND CONSTRUCTION - GENERAL	
527	601	Design	
527	603	Materials.	
527	605 (a)	Fabrication methods.	
527	607	Fasteners.	
527	609	Protection of structure.	
527	611	Inspection provisions.	
527	613	Material strength properties and design values.	
527	619	Special factors.	
527	621	Casting factors.	
527	623	Bearing factors.	
527	625	Fitting factors.	
		Personnel and Cargo Accommodations	
527	771 (a) (b)	Pilot Compartment	
527	773	Pilot Compartment view	
527	785 (a) to (h)	Seats, berths, litters, safety belts, and harnesses.	
527	787	Cargo and baggage compartments.	
527	807	Emergency exits	
527	831 (a)	Ventilation	
		Fire Protection	
527	853	Compartment interiors.	
527	855 (a)	Cargo and baggage compartments.	
		External Loads	
527	865 (a) – (e)	External loads	

AWM 527, Normal Category Rotorcraft			
CHAPTER	**REQUIREMENT**	**PARAGRAPH TITLE**	**EXCEPTIONS**
		SUBCHAPTER E - Powerplant - General	Repair only
		Powerplant Fire Protection	Repair only
527	1191	Firewalls	Repair only
527	1193	Cowling and engine compartment covering.	
527	1194	Other surfaces	
		SUBCHAPTER F - Equipment - General	
527	1301	Function and installation.	Limited to: Non-required equip. Non-complex avionics Non-integrated avionics
527	1307	Miscellaneous equipment	
527	1309	Equipment, systems & installations	
527	1321	Arrangement and visibility	
527	1322	Warning, caution & advisory lights	
		Electrical Systems and Equipment	
527	1351	General	
527	1357	Circuit protection devices	
527	1361	Master switch arrangement	
527	1365	Electrical cables and equipment	
527	1367	Switches	
		Lights	
527	1381	Instrument lights	
		Safety Equipment	
527	1411	General	
527	1413	Safety belts	
		SUBCHAPTER G - Operating Limitations and Information	
527	1529	Instructions for continued airworthiness	
		Markings and Placards	
527	1557	Miscellaneous markings and placards	
		Rotorcraft Flight Manual and Approved Manual Material	
527	1589 (a)	Loading information	
End of AWM 527			

AWM 529, Normal Category Rotorcraft			
CHAPTER	**REQUIREMENT**	**PARAGRAPH TITLE**	**EXCEPTIONS**
		SUBCHAPTER A - GENERAL	
529	1	Applicability.	
529	2	Special Retroactive Requirements	
		SUBCHAPTER B – FLIGHT – GENERAL	
529	29	Empty weight and corresponding center of gravity.	
		SUBCHAPTER C - STRENGTH REQUIREMENTS - GENERAL	
529	303	Factor of safety.	
529	305(a)(b)(1)	Strength and deformation.	
529	307 (a)(b)(2)	Proof of structure	
		Flight Loads	
529	337 (a)	Limit manoeuvering load factor	
		Emergency Landing Conditions	
529	561	General	
		SUBCHAPTER D - DESIGN AND CONSTRUCTION - GENERAL	
529	601	Design	
529	603 (a)	Materials.	
529	605 (a)	Fabrication methods.	
529	607	Fasteners.	
529	609	Protection of structure.	

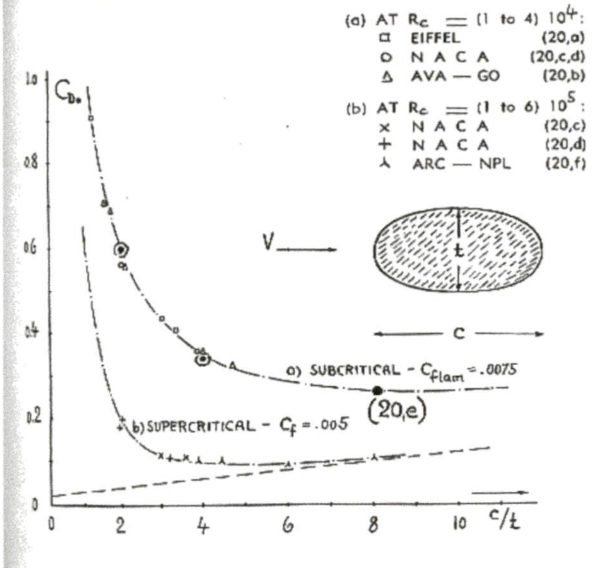


Figure 17. Drag coefficients of elliptical sections, (a) at subcritical R'numbers, (b) above the critical R'number.

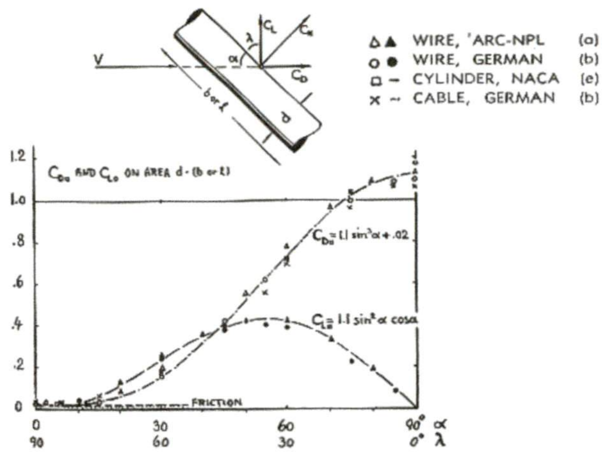


Figure 18. Drag (and lift) coefficients (on area "d" times axial length "l") of circular cylinders, wires and cables; inclined against the direction of flow — at Reynolds numbers below the critical. Reference (21).

Elliptical Sections are represented in figure 17. Equations have been developed similar to those in the "streamline" chapter — giving a suitable interpolation of the tested drag coefficients. At subcritical R'numbers,

$$C_{D\bullet} = 2\, C_{flam} (1 + c/t) + 1.1\ (t/c) \qquad (20)$$

Above the critical R'number range, the coefficient is approximately

$$C_{D\bullet} = C_{fturb}\left(4 + 2\ (c/t) + 120\ (t/c)^2\right) \qquad (21)$$

Optimum chord/thickness ratios (giving minimum $C_{D\bullet}$) are in the order of 9 below, and of 5 above the critical variation of the drag coefficient as against R'number.

---

(20) Experimental results on elliptical cylinders:
a) Eiffel in Nouvelles Recherches, Paris 1919.
b) AVA Struts, Tech Berichte I (1917) and II (1918).
c) NACA Tech Note 279 (1928) and Tech Rpt 289.
d) Jacobs, Streamline Wires, NACA T.Note 480.
e) Lindsey, Simple-Shape Cylinders, NACA T.Rpt 619.
f) British ARC, RM 1599 (1934) and RM 1817 (1937).

(21) Circular cylinders inclined against flow:
a) Relf and Powell, Tests of Smooth and Stranded Inclined Wires, ARC RM 307 (1917).
b) Mustert, Lift and Drag, German Doct ZWB FB 1690.
c) Kazakevich, Zh.Tekh.Fiz. 1951 p.1111; also Kuznetov, CAHI (Moscow) Rpt 98 (1931).
d) Thews-Landweber-Plum, Towing Cables, TMB Rpts 418 (1936) and 666 (1948).
e) Bursnall and Loftin, Pressure Distribution on Yawed Circular Cylinder in the Critical Reynolds Number Range, NACA T.Note 2463 (1951).

Cross-Flow Principle. A principle with quite a number of practical applications (see Index) is very well illustrated by the inclined circular cylinder in figure 18. At an angle of attack "α", flow pattern and fluid-dynamic pressure forces of such bodies only correspond to the velocity component (and the dynamic pressure) in the direction normal to their axis. Therefore (based on area $S_\square$ = dl, where l = length along axis):

$$C_{N\square} = N/qS_\square = C_{Dbasic}(\sin^2\alpha \text{ or } \cos^2\lambda) \qquad (22)$$

This force is then split up in the directions of drag and lift; hence:

$$C_{D\square} = C_{Dbasic}\,(\sin^3\alpha \text{ or } \cos^3\lambda) \qquad (23)$$

$$C_{L\square} = C_{Dbasic}\ (\sin^2\alpha\ \cos\alpha) \text{ or } (\sin\lambda\ \cos^2\lambda)$$

Experimental results in figure 18 on wires, cables and circular cylinders (at subcritical Reynolds numbers) confirm the prediction very well, after adding the frictional component $\Delta C_{D\square} = \pi\, C_f$.

At Supercritical Reynolds Numbers (that is, with essentially attached flow pattern), cross-flow conditions are different from those at subcritical Reynolds numbers. The pressure drag evidently depends on the skin-frictional losses along the surface, in which the axial velocity component takes part. A rough rule seems to be that between 0 and 50° angle of sweep or yaw "λ", the drag of a smooth cylinder in supercritical condition, is approximately constant, corresponding to a drag coefficient $C_{D\square}$ on "d" times (b or l) in the order of 0.2. Reference (21,e) also indicates that the critical speed of a

SUBPART C - STRENGTH REQUIREMENTS

FATIGUE EVALUATION

AC 27.571. § 27.571 (Amendment 27-26) FATIGUE EVALUATION OF FLIGHT STRUCTURE.

a. Explanation. An evaluation is required to assure structural reliability of the rotorcraft in flight. This evaluation may take the form of either tests or analysis. During the certification process, fatigue testing is more effective than analysis alone in identifying and preventing cracking that may occur during service. Analysis used for substantiation should be validated by tests.

(1) Chapter 3 AC 27 MG 11 contains background information and acceptable means of compliance with the requirements. A safe life may be assigned or the structure may be fail safe as prescribed or a combination of these may be used.

(2) Mandatory inspections, service life (replacement times) etc., determined in complying with the standard shall be placed in the Airworthiness Limitations Section of the Instructions for Continued Airworthiness (also called Maintenance Manual). See Appendix A of FAR Part 27, paragraphs A27.4 and paragraph AC 27.1529 for information.

(3) Amendment 27-26 amended the standard to require evaluation of the landing gear and their related primary attachments.

(4) Amendment 27-26 also amended the standard to require evaluation of ground-air-ground cycles on the rotorcraft, and if applicable, of external cargo operations. Previously external cargo operations were evaluated whenever the rotorcraft cargo combination exceeded the "standard" maximum certificated gross weight, and the CG range specified in § 27.25(c). If these limits were not exceeded, an evaluation was not required by the standard prior to Amendment 27-26.

b. Procedures.

(1) The fatigue evaluation requires consideration of the following factors:

(i) Identification of the structure/components to be considered.

(ii) The stress during operating conditions.

(iii) The operating spectrum or frequency of occurrence including frequency of ground-air-ground cycles, as well as external cargo operations.

(iv) Fatigue strength, and/or fatigue crack propagation characteristics, residual strength of the cracked structure.

(2) Since the design limits, e.g., rotor RPM (maximum and minimum), airspeed, and blade angles (thrust, weight, etc.) affect the fatigue life of the rotor system, it is necessary that flight conditions be conducted at limits that are appropriate for the particular rotorcraft and at the correct combination of these limits. It will be the responsibility of engineering and flight test personnel to determine that the flight strain program proposal includes conditions of flight at the various combinations of rotor RPM, airspeed, thrust, etc., that will be representative of the limits used in service. The flight test personnel should assure that the severity of the maneuvers to be investigated is such that actual service use will not be more severe. Verification that proposed maneuvers are suitable may be achieved by:

(i) Flying a representative set of maneuvers with the applicant's pilot in the test aircraft at noncritical combinations of weight, CG, and speed. (An FAA/AUTHORITY letter for specific test authorization would ordinarily be required.) If the procedure is used, the applicant should provide adequate preliminary flight strain data from development or other tests to confirm a cleared (non-critical) flight envelope for conduct of these representative maneuvers.

(ii) Flying a representative set of maneuvers with the applicant's pilot in a similar (certified) model to assess and agree upon the required maneuvers, control deflections, and aircraft rates. The required maneuvers or conditions will be specified in the flight strain program plan.

(iii) Flying a chase aircraft which has a flight envelope appropriate to allow visual confirmation of the proposed and programmed flight maneuvers.

(iv) Observation of telemetered flight data to assure desired control deflections, rates, and aircraft attitudes.

(v) Some combinations of items b(2)(i) through b(2)(iv) above.

(3) Assessing the operation spectrum and the flight loads or strain measurement program will involve airframe, propulsion, and flight test personnel.

(4) Variation in the operating or loading spectrum among models, and variations in the spectrum for a particular model rotorcraft, should be evaluated. Figure AC 27 MG 11-7 contains typical flight load measurement program conditions to be investigated. An example of a twin turbine spectrum is presented in Figure AC 27 MG 11-9. The tables should be used only as a guide and should be modified as necessary for each particular rotorcraft design.

(5) The difference in loading spectrum for different models that may be anticipated is illustrated by comparing the percentage of time assigned to level flight conditions, specifically 0.8 V_H to 1.0 V_H for three different rotorcraft designs as shown in figure AC 27.571-1. (V_H is the maximum airspeed at maximum continuous power in level flight.) The first column applies to a single-piston-engine powered small rotorcraft used in utility operations. The second column is appropriate for a single-turbine-engine powered seven-place small business and utility rotorcraft. The third column is appropriate for a twin-engine-powered 13 passenger transport rotorcraft. It should be noted that the level flight percentage of occurrences shown in figure AC 27.571-1 for the turbine utility business and turbine transport rotorcraft are examples of particular designs. The high percentage of time shown in this level flight regime could be unconservative for some designs, especially if the stresses under these design conditions produce an infinite fatigue life for the particular component. The fatigue spectrum percentage of occurrences should be modified according to the intended operation usage of the rotorcraft. However, a conservative application should be considered. This variation illustrates the "tailoring" of the loading spectrum for the type of rotorcraft and the anticipated usage.

FIGURE AC 27.571-1

Comparison Percent of Time in Level Flight

Piston Utility		Turbine Utility Business		Twin Turbine Transport	
0.8 V_{NE}	25%	0.8 V_H	16%	0.8 V_H	15%
1.0 V_H	15%	0.9 V_H	21%	0.9 V_H	20%
1.0 V_{NE}	3%	1.0 V_H	24%	1.0 V_H	38%
Total	43%		61%		73%

(6) External cargo operations are a unique and demanding operation. A "logging" operator may use 50 maximum power applications per flight hour to move logs from a cutting site to a hauling site. Power is used to accelerate, decelerate, or hover prior to load release. Lifting loads over an obstruction or natural barrier is another example of very frequent high power applications for takeoff and for hovering over the release area. Similar types of operations require flight loads data to assess the effects on fatigue critical components.

(7) The impact of the external cargo operation on standard configuration limits should be assessed to determine whether or not the component service lives, inspections, etc., will be affected. The assessment may be done by calculating an "external cargo configuration" service life for each critical component. The lowest

service life obtained from standard configuration flight loads data and loading spectrum, or from external cargo configuration flight loads data and loading spectrum or from frequent ground-air-ground cycles is generally the approved service life or replacement time. Since the regulatory maintenance and operating rules do not require recording time in service for the different types of operations, this procedure could be used if an "operational cycles" equation for equivalent flight hours is not approved (see (8) below).

(8) The Airworthiness Limitations Section of the maintenance manual shall contain the required information derived from complying with the standard. If an "operational cycles" equation for "equivalent flight hours" is approved under the standard, the equation is included in this approved section of the manual.

(9) The applicant should plan to conduct a flight loads survey program for both a standard configuration and an external cargo configuration, if applicable. The ground-air-ground cycle is inherent in these conditions. This procedure will avoid delays associated with reinstallation and calibration of equipment.

AC 27.571A. §27.571 (Amendment 27-33) FATIGUE EVALUATION OF FLIGHT STRUCTURE FOR CATEGORY A CERTIFICATION.

a. Explanation. Amendment 27-33 added Appendix C to specify the requirements for Category A certification of normal category rotorcraft. The requirement for fatigue tolerance evaluation will require test evidence to support the analysis.

b. Procedures. For Category A certification, the tests specified in paragraph AC 29.571A are required for fatigue tolerance evaluation. Paragraph AC 29.571A is repeated in this section.

(1) Fatigue test evidence is necessary for the fatigue evaluation of gears. The test evidence should be provided by rotating tests of complete gearbox specimens operating under power. The tests provide the basis for analysis leading to the establishment of safe life.

(2) The tests are conducted specifically for the purpose of gear tooth evaluation, and components subjected to the tests do not have to be considered serviceable on completion of the test. Excessive wear on bearings and shafts and marking (including spalling) of bearings and gear teeth are acceptable provided no fatigue damage is evident on the gear teeth. However fatigue damage other than tooth fatigue should be considered for test validity and the integrity of the affected part confirmed as necessary.

(3) The test conditions (torque versus number of cycles) should permit the setting of mean strength curve(s) to be associated with each primary gear in the drive train. The test conditions, should at a minimum, encompass those power levels for which repeated application inservice is expected under normal circumstances. The S-N curve(s), for the material and type of gear, should be reduced by a factor of safety to

CHAPTER 3
AIRWORTHINESS STANDARDS
NORMAL CATEGORY ROTORCRAFT

MISCELLANEOUS GUIDANCE (MG)

AC 27 MG 11 FATIGUE EVALUATION OF ROTORCRAFT STRUCTURE

a. Purpose. This revision to the advisory circular sets forth acceptable means of compliance with the provisions of Federal Aviation Regulations, §§ 27.571 and 29.571, dealing with the fatigue safe-life evaluation of metallic rotorcraft structure. The previous general guidance for fail-safe methodology is retained herein, as this approach also remains an option for compliance with Federal Aviation Regulation, § 27.571. General guidance and some background to fatigue evaluation issues are also provided. Guidance for evaluation of composite structure may be found in Chapter 3, AC 27 MG 8, AC No. 20-107A, and AC 29-2C.

b. Background. The fatigue evaluation procedures outlined in this advisory circular are for guidance purposes only and are neither mandatory nor regulatory in nature. Although a uniform approach to fatigue evaluation is desirable, it is recognized that in such a complex problem, new design features and methods of fabrication, new approaches to fatigue evaluation, and new configurations may require variations and deviations from the procedures described herein. Engineering judgment should therefore be exercised for each particular application. The flight structure of the rotorcraft is subject to cyclic vibratory stresses in practically every regime of flight. In addition, since it is a highly maneuverable aircraft that is capable of forward, rearward, sideward, vertical, and rotational flight, operating limitations due to fatigue are possible in practically all flight situations. For these reasons, it is required that special attention be focused on the fatigue evaluation of the flight structure of the rotorcraft.

(1) Fatigue evaluation of the flight structure is intended to verify structural reliability. Assurance of structural reliability starts with design, including choice of materials for resistance to crack initiation and/or propagation, detail design to minimize stress concentration, and specification of surface finishes, fits, etc. Design analysis should include estimation of expected flight loads, and estimation of resistance to fatigue. Fatigue strength should be based on past full-scale fatigue tests and/or materials fatigue data with appropriate reductions for the variability in fatigue strength, size, shape, surface finish, and environments of the structure. In addition, design for fatigue should consider mode-of-failure analysis, areas susceptible to fatigue cracking, and methods to assure detectability of fatigue cracks; when fail-safe design is the chosen method. The residual strength of a cracked structure is an important consideration of fail-safe design.

(2) Assurance of structural reliability also includes manufacture and fabrication in accordance with design requirements and specifications, quality control to monitor compliance, and effective service inspection procedures.

(3) Fatigue evaluation of the structure, measurement of flight loads and stresses, and evaluations of fatigue strength and/or fatigue crack propagation are the subjects of this advisory circular. There is some question whether a completely reliable method for the prediction of time to fatigue crack initiation and fracture exists. Nevertheless, one engineering approach to the subject is to use the "Linear Cumulative Damage Hypothesis." This hypothesis states that every cycle of stress above an "endurance limit" produces fatigue damage proportional to the ratio of cycles accumulated at the stress to fatigue "life" at that stress.

(4) Laboratory tests of this hypothesis indicate that it is reasonably valid when the loading spectrum consists of stresses that are, in effect, random. Despite the lack of an adequate theory connecting this hypothesis with more basic properties of materials, it has been successfully used in a number of applications to calculate a safe-life retirement time.

(5) In addition, fatigue evaluation generally requires a method of accounting for the effect of steady loads and stresses on fatigue. Where the manufacturer does not provide other substantiating data, a Goodman diagram may be used to account for these effects.

(6) In any rational fatigue evaluation, the following factors should be considered:

(i) Identification of the structure to be considered in the fatigue evaluation. Those elements of the rotorcraft structure that may be critical in fatigue should be identified. Typical elements include:

(A) Rotor blades and attachment fittings.

(B) Rotor heads, including hubs, hinges, dampers.

(C) Rotor drive components, including gearboxes and transmission shafts.

(D) Control system components, including control rods, servos, swashplates.

(E) Rotor supporting structure.

(F) Primary flight and ground load paths of the fuselage, including landing gear, lift frames, stabilizers and auxiliary lifting surfaces.

(ii) The loads and stresses associated with steady and maneuvering operating conditions expected in service.

(iii) The frequency of occurrences associated with various flight conditions and the corresponding spectrum of loading and stresses.

(iv) The fatigue characteristics of the structure, including fatigue strength, and as necessary, crack propagation and residual strength characteristics.

c. Flight Load Measurement Program.

(1) General. Subsequent to design analysis, in which aircraft loads and associated stresses are derived, the stress level and/or loads are to be verified by a carefully controlled flight load measurement program. The flight load measurement program shall demonstrate maximum and minimum loads for the entire flight envelope. It shall also gather steady and cyclic load/strain data for use in the fatigue evaluation required by §§ 27.571 and 29.571. The parameters to be measured are primarily load calibrated strains supported by local strain measurement, accelerations, and deflections as necessary.

(2) Instrumentation.

(i) The instrumentation system used in the flight parameter measurement program should accurately measure and record the critical parameters under operational test conditions. For critical maneuvers, the instrumentation should be capable of recording data sequences for several related channels for stationary and rotating channels. The location and distribution of the strain gauges should be based on a rational evaluation of the critical stress areas. Appropriate analytical methods should be used, such as Finite Element Modeling (FEM) and may be supplemented by other techniques including strain sensitive coatings, photoelastic methods, and thermography. Manual calculations based on the historical precedent of similar structure can also be very helpful. As much as possible, the instrumentation plan should standardize the gauge locations for each component so that all testing and other experience can be related to the same common set of measurement parameters. The gauge sensitivity, frequency response, location, distribution, and number of strain gauges must provide the strain/load spectrum and strain/load distribution for each part essential to the safe operation of the rotorcraft.

(ii) The corresponding flight and ground operation parameters (airspeed, rotor RPM, center of gravity accelerations, etc.) should be recorded simultaneously and, where appropriate, as time histories. This is necessary to correlate the loads and stresses with the maneuver or operating condition during which they occurred. If the number of data parameters required exceeds the system capability, enough "carry-over" data channels should be included to reasonably relate all data for the specific maneuver when several flights are necessary.

(iii) The instrumentation system should be adequately calibrated and checked frequently during the strain survey. Ideally this would occur at the beginning

and end of a flight. Strain gauges should be temperature compensated where necessary.

(iv) In the case of calibrated structure, rational evaluation of the calibration rig procedure should be performed to demonstrate that strain-load response is representative over the range of flight maneuvers and operational parameters that are to be encountered. As a minimum, the calibration fidelity should address the loading distributions applicable to the critical failure modes of the component under evaluation and over a high percentage of the maximum expected flight load. Care should be taken to ensure that any non-linear behavior is identified and properly considered.

(3) Parts Subject to Flight Measurement. Sufficient parameters of the rotor systems, drive systems, control systems, fuselage, and supporting structure for rotors, transmissions, engines, APU's, and other dynamic components should be measured to adequately define and substantiate the loading of these components. For rotorcraft of unusual or unique design or operation or employing unusual equipment, special consideration should be given to the unique features and also the effects they may have on existing systems and structure.

(4) Flight Regimes and Operational Conditions to be Investigated.

(i) Typical flight and ground conditions to be investigated are given in Figure AC 27.MG 11-7 for conventional passenger/utility use and additional conditions in Figure AC 27.MG 11-8 for a lifting operation. For intensive lifting missions it should be recognized that lifting conditions for both internal and external loads should be investigated including landing with and without load as applicable. Figures AC 27.MG 11-2 and AC 27.MG 11-3 show flight regimes that should be investigated for power-on and power-off operation for all helicopters. Parameters, which define these regimes, are included in these figures. Other parameters such as Gross Weight and C.G. apply and should be included. The effects of temperature and of high altitude operation or altitude cycling should be investigated. As noted on Figure AC 27.MG 11-2, complete coverage at 111 percent V_{NE} should be demonstrated for power-on operation. However, for power-off operation, Figure AC 27.MG 11-3, complete coverage at 111 percent V_{NE} for maximum and minimum design RPM need not be obtained if points are obtained at V_{NE} at both maximum and minimum design RPM and at 111 percent V_{NE} at both maximum and minimum placarded RPM as indicated in the figure. Conditions arising out of special requirements such as those imposed by noise reduction and near surface operation should also be investigated.

(ii) The determination of the flight conditions to be investigated in the flight strain measurement program should be based on the anticipated uses of the helicopter. Information from similar designs and/or similar operations should be assessed and used where applicable. Flight conditions considered appropriate for the design and application must be representative of actual operation in accordance with the rotorcraft flight manual. For multi-engine helicopters, the flight conditions concerning engine out operations should be considered in addition to complete power-

off operation. For heavy lift and external-lift helicopters the loaded and unloaded conditions of operation should be investigated in conjunction with other important parameters. When the mission being evaluated involves the use of a long line, the flight strain survey should be flown with a long line. This will insure that the correct rotor and control loading will be duplicated particularly in hover and low speed maneuvers since the c.g. offset, drag, and inertia effect of the external load can be a factor in dynamic loads. Generally the V_{NE} when performing external cargo missions is reduced because of safety or other reasons. In addition, for these uses, and others where the operation requires frequent excursions to the proposed limitations of the rotorcraft, reasonable consideration should be given to unintentional exceedences and the development of these limits. The extent of the assessment would generally be founded on experience, but also acknowledging tolerances in instrumentation and the circumstances of the operation, particularly the level and focus of pilot workload. Similarly the effects of structurally significant maintenance should be investigated as necessary, particularly where unusually large load amplifications could be expected as a consequence and the probability of occurrence is shown or believed to be substantial based on experience. Operating limitations and maintenance instructions may be adjusted on the basis of these investigations. For all rotorcraft the effects of ground operation should be investigated. The ground and flight conditions to be investigated should be submitted as part of with the flight evaluation program.

(iii) The severity of maneuvers investigated during the flight strain survey should be such that it is extremely unlikely that service use will be more severe. In this evaluation, flight replications should be investigated during the load survey so that normal and expected variations in achieving the specific target flight test conditions are accounted for.

(iv) The extremes of aerodynamic configuration, including operation with doors off or open and simultaneous use of equipment, should be investigated as well as the usual parameters. In addition, when the rotorcraft is equipped with externally mounted devices such as rescue hoist, spotlight, camera, infrared sensors, etc. it is necessary to evaluate the loads. These or similar devices can increase the profile drag thus increasing power required. Additionally, the airflow from these devices can impinge on the tail boom, fin or tail rotor altering the loads determined for the clean aerodynamic configuration. When these devices are installed by a modifier as a Supplemental Type Certificate (STC), it is the responsibility of the STC holder to investigate any effects the device may have alone or in combination with other externally mounted devices.

All flight conditions considered appropriate for the particular design are to be investigated over the complete rotor speed, airspeed, longitudinal and lateral center of gravity, altitude and weight (from minimum mission weight to maximum mission weight) ranges to determine that the critical loads/stresses associated with each flight condition are identified. Typical damaging flight conditions for main rotor components and suspension include, but are not limited to: high speed flight, turns, pull-ups, sideward flight, approach, autorotation, taxiing, take off and landing on slopes. For tail rotor

components, typical flight conditions to evaluate include, but not limited to: spot turns in hovering, sideward flight or level flight with sideslip. In order to account for data scatter and to determine the load/ stress levels present, a sufficient amount of data points should be obtained at each flight condition. In some instances, the critical weight, center of gravity, and altitude cases for the various maneuvers can be based on validated flight loads analysis or on past experience with similar designs. This procedure is acceptable where adequate flight tests are performed to substantiate such selections. The combinations of flight parameters that produce the most critical load/stress levels should be included in the fatigue evaluation. In addition attention should be paid to the influence of temperature through the whole range certified, especially to very cold temperature (typically below -30°C [= -20°F]). For example, the characteristics of elastomeric components in rotor assemblies are particularly sensitive to temperature change. This influence can be evaluated either in flight during a cold weather campaign or by analysis based on elastomer characteristics such as stiffness and damping measured in a cold temperature chamber.

d. Frequency of Occurrence (Usage) Spectrum.

(1) General. The frequency of occurrence spectrum (often called usage spectrum) defines the maneuvers the rotorcraft will perform in the various types of operation, and the percentage time or number of events associated with each maneuver. The diversity of rotorcraft sizes and speed together with the wide range of passenger/cargo capability requires that a comprehensive evaluation of each possible mission scenario be accomplished for each rotorcraft model. Some of the most common types of operation include transport, offshore support, traffic reporting, emergency medical services (EMS), law enforcement, search and rescue, agricultural spraying and external sling operation. Each of these operations has unique requirements in terms of maneuvers, gross weight/center of gravity and altitude. However, each helicopter model may fly one or more of these operations throughout its operational lifetime. Replacement times should account for the worst case operation for each component, unless a method approved by the Authorities is developed which allows consideration of multiple type of operations by factoring hours or counting events.

(2) Spectrum Development. The frequency of occurrence spectrum should be based on information that is applicable to the mission(s) the rotorcraft is to perform. All damage that is likely to occur in actual usage should be accounted for including low cycle damage from power cycles and the ground-air-ground (GAG) cycle. This information may come from direct measurement of usage data from the same or similar rotorcraft, usage monitors, questionnaires or direct observation of the helicopter performing the mission. Design limitations established in compliance with §§ 27.309 or 29.309 and any recommended operating conditions and limitations established and specified in the rotorcraft flight manual should also be reflected in the spectrum. An example of a twin turbine spectrum is presented in Figure AC 27.MG 11-9. This table should be used only as a guide and should be modified as necessary for each particular rotorcraft. An example of the diversity in the frequency of occurrence spectrum is

illustrated by comparing percentages of time assigned to level flight conditions for three different rotorcraft types as shown in Figure AC 27.MG 11-1 below:

Piston Utility			**Turbine Utility Business**			**Twin Turbine Transport**	
0.8 V_{NE}	25%		0.8 V_H	16%		0.8 V_H	15%
1.0 V_H	15%		0.9 V_H	21%		0.9 V_H	20%
1.0 V_{NE}	3%		1.0 V_H	24%		1.0 V_H	38%
TOTAL	43%			61%			73%

FIGURE AC 27.MG 11-1: Example of the variation in time spent in level flight for three rotorcraft types.

Not only are the totals different for the different rotorcraft types but the distributions of time are also significantly different. This can become an important factor in the determination of fatigue lives, whether or not there are damaging loads in level flight, depending on how the time spent in other maneuvers is subsequently proportioned. A conservative approach to the spectrum development should be taken. It is suggested that a sensitivity study be conducted to determine the variability of component lives to different assumed percent times for level flight. This same procedure might also be used for other elements of the spectrum where significant fatigue damage is incurred. The results from such a study may be used to influence the spectrum or the replacement time assigned to the component(s).

(3) External Load Operations. The unique ability of a rotorcraft to hover makes it particularly useful in moving external cargo. External load operation can be a demanding mission requiring the maximum lifting and power capability of the rotorcraft at a high rate. For example, a logging operator may use up to 50 maximum power cycles per flight hour to move logs from a cutting site to a hauling site. The power reaches a maximum limit when the load is lifted and the rotorcraft accelerates. The power reaches a minimum during the descent and will peak again if the rotorcraft decelerates and transitions to hover to release the load. Other external cargo operations with similar characteristics are fertilizer spreading, water bucket operations, and replenishment of remote oil exploration sites, etc. These power excursions are particularly critical for the rotorcraft drivetrain components. The impact of external load operation should be assessed to determine if replacement times would be affected.

(4) Management of Replacement Time.

(i) The lowest calculated life obtained from all flight loads data and loading spectrum (including external load operations) is generally the basis for establishing the replacement time of the component(s). Regulatory maintenance and operating rules do not require recording time-in-service for different types of operations.

However, it may be possible to adjust replacement times by counting events or by factoring flight hours for certain types of operation. Any such procedure will require the approval of the certification authority for a suitably amended airworthiness limitation section and should also consider the operational aspects involved. For example, a component where significant damage occurs during the GAG or power cycle may more appropriately be assigned a life in terms of the number of cycles of takeoffs or lifts in lieu of tracking flight time in hours. The cycles should be properly defined and related to events that are easily identified and recorded by the crew or by an approved usage monitor (e.g., takeoffs or lifts). This example procedure would retire the component sooner when it is used in an external load operation mission involving many cycles per flight hour. Conversely, an operator performing a less severe operation standard mission could leave the component in service longer since fewer cycles are accumulated. This procedure would permit the rotorcraft to be used for different types of operations and still ensure a safe replacement time for the component.

(ii) Where appropriate, some of the basic usage assumptions made in the fatigue evaluation which the operator can reliably assess (such as numbers of ground air ground cycles) should be noted in the airworthiness limitations section of the maintenance manual. The intent of this would be to make operators aware of these criteria so that appropriate actions may be taken.

(iii) Should subsequent usage of the rotorcraft encompass an operation for which the original structural substantiation did not account, the effects of this new operation should be addressed, and in the interests of safety, a reassessment made. Subsequently, if the replacement times require revision, those new times may be limited to aircraft involved in the new operation provided:

(A) Proper part re-identification is established;

(B) a rotorcraft flight manual supplement outlining limitations is approved;

(C) an airworthiness limitations section supplement is approved; (this is also required for incorporation of new methods for managing replacement times, see paragraph d4(i) above); or,

(D) a combination of the above.

e. <u>Fatigue Life Evaluation.</u>

(1) <u>General</u>. Information for fatigue evaluation based on safe-life considerations leading to replacement times is provided in this section. Although there is a large quantity of information available on the fatigue strength characteristics of material specimens, built-up specimens and parts, the prediction of the strength of parts of new designs based on this information is less accurate than testing the actual part. Consequently, for an analysis based on test data other than the actual part to be considered acceptable, additional conservatism should be used to achieve similar levels

of reliability and safety as obtained with a full scale test approach. However, in many cases the differences between past test specimens and the actual part (which involve such factors as stress concentration, size, and fretting) cannot be accounted for with a reasonable degree of accuracy. Therefore, it is usually necessary that the structural components be subjected to repeated load tests using information determined in the flight load measurement program. Special operational or functional characteristics that could affect the fatigue strength should also be considered in the service life evaluation. Such factors as high blade operating temperatures due to tip jets or turbine exhaust impingement on the tail rotor should be considered as well as other special operating conditions. In addition, effects of special purpose use such as hoist and external operation, spraying, surveying, etc., should be considered if appropriate to the particular type. The fatigue strength may be evaluated using the methods outlined below, of which full scale testing is the preferred method.

(2) Analytical Methods

(i) Simplified method. This method requires that an operating boundary for stress levels be established. The following techniques that account for the effects of cyclic and steady stresses are considered acceptable for establishing the allowable stress levels:

(A) The mean endurance limit of the part should first be estimated from simple material test specimens. The test specimen material should be representative of the actual part and sufficient test data should be available to substantiate a mean endurance limit (the reference specimen endurance limit, Line AD of Figure AC 27.MG 11-4). A range of cycles from 10^7 to 10^9 may be appropriate to estimate the endurance limit dependent on the material. The estimate should account for surface conditions, fabrication methods, fretting, size and shape effects, and environmental conditions, as well as differences in stress concentrations between the test specimen and the actual part. Referring to Figure AC 27.MG 11-4, the endurance limit of the part may be represented by a straight line drawn through the yield stress (point D on the horizontal axis) and the mean endurance limit from test results, suitably adjusted to account for the considerations detailed above, at a given steady stress. The intersection of this line with the vertical axis is point B. This produces the adjusted specimen endurance limit, line BD.

(B) A factor or safety of 3 should then be applied to the adjusted specimen endurance limit so that the slope of line CD (the operating boundary) would be 1/3 of line BD.

(C) If all operating stress cycles fall below the operating boundary line (CD), no fatigue testing is necessary. When any of these stresses are above the operating boundary line, fatigue testing of the actual parts should be conducted, unless a suitably conservative approach such as that outlined in d(4)(ii) is adopted.

(D) Caution should be exercised in the application of the analytical method above, particularly when the following items are involved:

(1) Irregularly shaped parts containing numerous or super-imposed fillets, holes, threads, or lugs.

(2) Large parts in proportion to the laboratory specimens.

(3) Parts or unique design for which no past service experience is available.

(4) Parts subject to fretting.

(5) Bolted or pinned connections.

(6) Complex castings.

(7) Welded sections.

(8) New materials or processes without precedent of use.

(ii) Rational methods. The previous simplified method can be overly conservative, especially when only ground-air-ground cycles or very high loads associated to very low occurrences fall over the operating boundary line defined in paragraph e(2)(i) above. Consequently methods may be used which do not involve full scale testing but which apply the same principles of calculation of retirement times, based on:

(A) An S/N curve shape representative of the material of the component.

(B) A mean fatigue limit representative of the component, considering as necessary, the steady flight loads, fretting effects, and all the other influential parameters of paragraph e(2)(i)(A).

(C) An appropriate factor applied to the mean fatigue strength to produce a working limit (typically 1/3 of mean strength).

(D) Consideration of all the loads from the complete flight loads spectrum.

(E) The use of the Miner linear cumulative damage hypothesis, including both low cycle and high cycle fatigue damages.

(iii) In order to provide an acceptable alternative to the fatigue testing and simplified analytical methods, these rational methods should be based on a validated stress analysis. Finite element model correlated to strain gauge measurements for example, or previous experience of similar designs may be acceptable. The material

fatigue behavior should be well established for each application. It is important to apply the chosen method consistently and should any of the analyses identify the need for a replacement time, testing should be conducted to support the assumptions made. The certifying authority should approve these rational methods.

(3) Testing Methods. The fatigue strength of the flight structure may be determined in appropriate laboratory tests and evaluated in terms of the loading spectrum. The mean strength indicated by the test results should be reduced by a factor or factors such that the probability of occurrence of a lower strength part in service is very low. This conservative treatment of strength combined with a conservative treatment of both the flight loads (paragraph c.) and their frequency of occurrence (paragraph d.) must assure that the probability of failure is extremely remote. All test articles should be fully representative of the design standard selected for evaluation, including the processes used in manufacture. The test fixture should be capable of applying the loading conditions in a way that loads the component in the same manner as when on the rotorcraft. The test loads developed in the component should be correlated with those measured in the flight load survey.

(i) S/N Curves. Constant amplitude fatigue tests should be conducted to define the mean strength. Whenever possible several S/N data points should be established for each of a number of different alternating load levels. The fatigue tests should be performed at mean stresses or loads representative of those occurring in flight. In addition, some components subjected to both dynamic and low cycle loading, for example a main rotor blade, may require the addition of a start-stop or GAG cycle testing, and the resulting fatigue damage included in the component life determination. In order to determine the mean fatigue strength, it is necessary to test actual components. These tests will allow the construction of the mean S/N curve when combined with an established curve shape. The S/N curve shape may be derived by using a least square fit curve through coupon data or appropriate published material data. Care should be taken in the selection of curve shape, particularly when fretting is present. Then, to account for fatigue strength variability, the mean curve must be reduced to a working curve. In establishing the working curve, consideration should be given to the number of specimens tested, the variability of the fatigue results, previous test data on the same material or similar components, as well as service experience. At least four full-scale specimens are recommended, but fewer may be adequate in association with a conservative approach to establishing the working curve considering the reduction in reliability this infers. Current practice shows that when four or more specimens are used, the resulting working curve (Figure AC 27.MG 11-5) can range from 51% to 70% of the mean curve in strength for aluminum alloys and 56% to 75% for steels. The successful application of the resulting working curves will depend on the degree of conservatism shown in the flight loads and occurrence spectra. Therefore it follows that use of the least conservative of these working curves would necessitate the greatest conservatism in the flight loads and assumptions relating to likely operational use. Consideration should also be given to fatigue life reduction factors when constructing the working curve. Typical factors range from around four to ten at less than 100,000 cycles. It may be possible to determine reduction factors from a large

database of historical test data of components with similar characteristics. Care should be exercised when pooling such data to be sure that difference in failure modes and curve shapes are considered. Whatever reduction factor is selected, a rationale should be provided to substantiate it. The reduced S/N curve and the loading spectrum developed per paragraph c. and d. should be used in determining replacement times, see paragraph e(4).

(ii) Spectrum tests. The establishment of replacement times based on fatigue tests in which each specimen is subjected to a spectrum of loading is to include the following considerations:

(A) Definition of the test loading spectra based on either:

(1) Load histories based on flight test data obtained for flight and ground conditions and maneuvers considered appropriate for the particular rotorcraft, and a spectrum allocating percentages of time or frequencies of occurrence to these flight and ground conditions and maneuvers, or

(2) Analysis supported by extrapolation of available load history data or prior knowledge where available.

(B) The effects of high infrequent load cycles on the test result particularly when such cycles may occur only rarely in service.

(C) The effects of omitting low load (high frequency) cycles to reduce test time should be fully established and supported by test experience to be adequately accounted for.

(D) Fatigue tests in which the loading spectra are applied such that effective randomization of loading is obtained.

(E) Assignment of replacement times. The fatigue test results should be evaluated in terms of the loading spectrum of paragraph d. if different to the test spectrum, and reduced by factors for strength and life based on similar approach to those derived for the constant amplitude tests above.

(4) Safe-Life Calculation Methodology. The key procedures for safe life determination, as shown hereafter, are based on the three basic elements of strength, loads, and usage as established in the preceding sections. These elements are reiterated below and combined according to Figure AC 27.MG 11-6 to calculate the retirement life: 1) The conservative working S/N curve developed from the mean S/N strength curve of the component using reduction factors based on the material and manufacturing variability and test parameters. 2) Loads and usage combined in an individual fatigue loads spectrum for the component determined conservatively through test and analysis. The loads may be processed by conservative methods using maximum load for the duration of each condition or by suitable cycle counting methods.

GAG cycles, once per maneuver cycles, and other high load cycle events should be accounted for as the loads are combined with the established usage spectrum. The service life of the component may then be determined using Miner's linear cumulative damage rule, considering both high and low cycle fatigue damage. The calculated service life obtained for a total damage equal to one is then the maximum allowable replacement time for the component.

f. Fail-Safe Evaluation.

(1) General. The fail-safe evaluation of the flight structure is intended to ensure that, should fatigue cracks initiate, the remaining structure will withstand service loads without failure until the cracks are detected. The fail-safe evaluation generally encompasses establishing the components which are fail-safe, defining the loading conditions and extent of damage for which the structure is to be designed, conducting structural tests and analysis to substantiate that the design objective has been achieved, and establishing inspection programs to assure detection of fatigue damage. Design features that may be used in attaining a fail-safe structure are:

(i) Selection of materials and stress levels that provide a controlled slow rate of crack propagation combined with high residual strength after initiation of cracks.

(ii) Design to permit detection of cracks, including the use of crack detection systems, before the cracks result in an appreciable loss of residual strength.

(iii) Use of multi-path construction and the provision of crack stoppers to limit the growth of cracks.

(iv) Use of composite duplicate structures so that a fatigue crack or failure occurring in one element of the composite member will be confined to that element and the remaining structure will still possess limit load-carrying ability. It may be necessary to employ the design techniques of f(ii) above to assure effectiveness of these features.

(v) Use of backup structure wherein one member carries the entire load, with a second member available and capable of assuming the load if the primary member fails.

(2) Extent of Fail-Safe Damage. The extent of the partial failure is to be such that it would be readily detectable during the specified inspection. It may involve complete failure of a principal element, failure of more than one element, or only a partial failure of an element, depending on the rate of crack propagation, the ease of detection, and the inspection interval. Damage in inaccessible areas should extend into inspectable areas.

Typical examples of the fatigue damage that should be considered are outlined below:

(i) Cracks emanating from the edge of structural openings or cutouts which can be readily detected by visual inspection of the area.

(ii) A circumferential or longitudinal skin crack in the basic fuselage structure of such a length that it can be readily detected by a visual inspection of the surface area.

(iii) Complete severance of interior frame elements or stiffeners in addition to a visually detectable crack in the adjacent skin.

(iv) Failure of one element in a multiple load path design.

(v) Failure of primary attachments, including control hinges and fittings.

(3) Determination of Probable Crack Locations. The probable crack locations are to be determined by tests, analysis, or both. In cases of unusually critical or complex components or when initial fatigue loading may affect the rate or mode of cracking, the probable crack locations should be determined by fatigue test. When determination is made by analysis, sound engineering judgement should be used and a variety of factors such as the following should be taken into account:

(i) Conducting an analysis to locate areas of maximum stress and low margin of safety.

(ii) Conducting strain surveys on undamaged structure to establish points of high stress concentration as well as the magnitude of such concentration.

(iii) Examining static test results to determine locations where excessive deformation occurred.

(iv) Determining from fatigue analysis where cracks may initiate.

(iv) Selecting locations in an element where the stresses in adjacent elements would be the maximum with that element failed.

(v) Selecting partial fracture locations in an element wherein high stress concentrations are present in the residual structure.

(vi) Assessing design detail areas which are prone to fatigue damage such as joints, holes, and other features as based on service and test experience of similarly designed components.

(4) Fail-Safe Demonstration. It is to be demonstrated by analysis, tests, or both, that the structure with the partial failures as defined in paragraphs f(2) and f(3) can withstand the maximum load and the repeated loads expected in service during the period prior to detection. The repeated loads should be as defined in the loading

spectrum of paragraph d(2) and the structure should be capable of supporting this loading after a partial failure for a sufficient time with respect to the inspection interval to assure that catastrophic failure is extremely remote. In test demonstrations, the damage may be initiated or simulated by cuts made with a fine saw, sharp blade, or guillotine in those cases where it is not necessary and not practical to produce fatigue cracks by tests. In those cases where damage is simulated at joints or fittings, bolts may be removed to simulate failure if this condition would be representative of an actual failure. In some instances, the fail-safe characteristics may be shown analytically. The analytical approach may be used when the structural configuration involved is essentially similar to one already verified by fail-safe tests, whether on a previously approved type design, or on other similar areas of the design currently being evaluated. The analytical approach may also be used when:

(i) It can be shown that the failure would be detected considerably before the critical crack length is reached;

(ii) The margins of safety resulting from the analysis are well in excess of the fail-safe residual static strength level; and,

(iii) The stress levels in the partially failed structure and the design are such as to assure adequate crack propagation time relative to the inspection interval.

(5) Inspection. Detection of fatigue cracks before they become dangerous is the ultimate control in ensuring the fail-safe characteristics of the structure. Therefore, the manufacturer should provide sufficient guidance information to assist operators in establishing the frequency and extent of the repeated inspections of the critical structure.

g. Further Considerations.

(1) Control of Fatigue Sensitive Parts. Control of the part in manufacture, operational service, and maintenance is vital to ensure the full benefits of the fatigue life substantiation process. Any part that has been selected for fatigue assessment should be considered using the following guidance. This is particularly important for safe life parts with no damage tolerance capability. The details of the manufacturing procedures and processes for fatigue sensitive parts, including material manufacture and source, forging procedures, machining operations and sequence, and inspection techniques and acceptance and rejection criteria should be established. Sensitivity should be established on the basis of identifying the processes, which if incorrectly completed could significantly affect the fatigue life. The tested components should be produced in accordance with the above manufacturing procedures. For life-limited and fatigue sensitive parts, the design and manufacturing standards should be frozen subject to further evaluation by the design authority. Parts produced in whole or in part under sub-contracting or partnership arrangements should be subject to the same procedures. Life-limited and fatigue sensitive parts should be marked with a serial number and records relating to the marking maintained, such that it is possible to establish the

relevant manufacturing modification and service history of the individual parts. Special instructions should be provided, as necessary, to ensure the part is handled in an appropriate manner, particularly during maintenance. Processes for determining the disposition of parts having manufacturing errors or material flaws should be established. In a similar manner, processes controlling changes to the design or manufacture of the component or to its operating environment or loading spectrum are required. For any such changes, their effects on the fatigue evaluation of the part should be established. This evaluation should involve further fatigue testing, unless it can be shown that testing is not necessary.

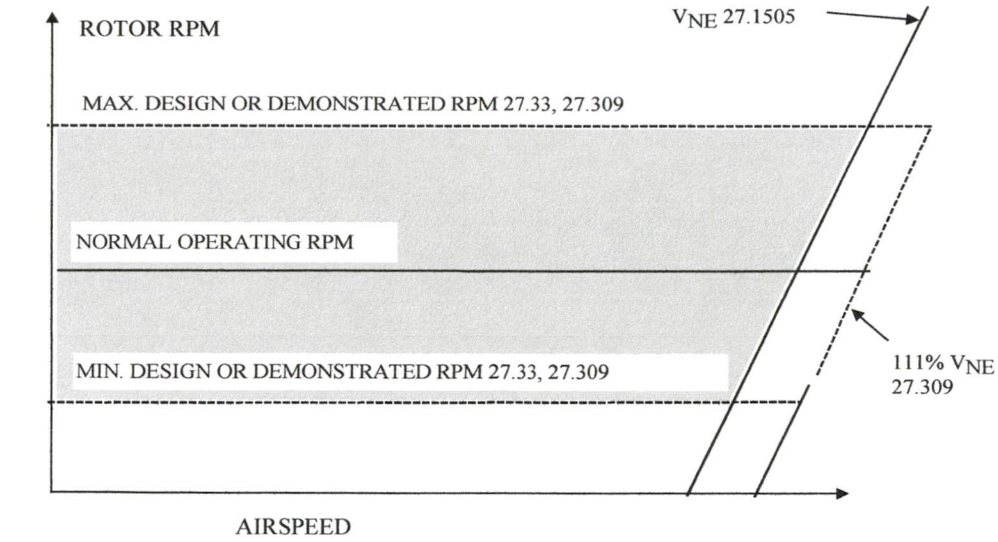


FIGURE AC 27.MG 11-2: Flight Regime to be Investigated Power-On Operation.

(Note: Dashed lines in these figures indicate test boundaries. Shaded areas indicate operating regimes.)

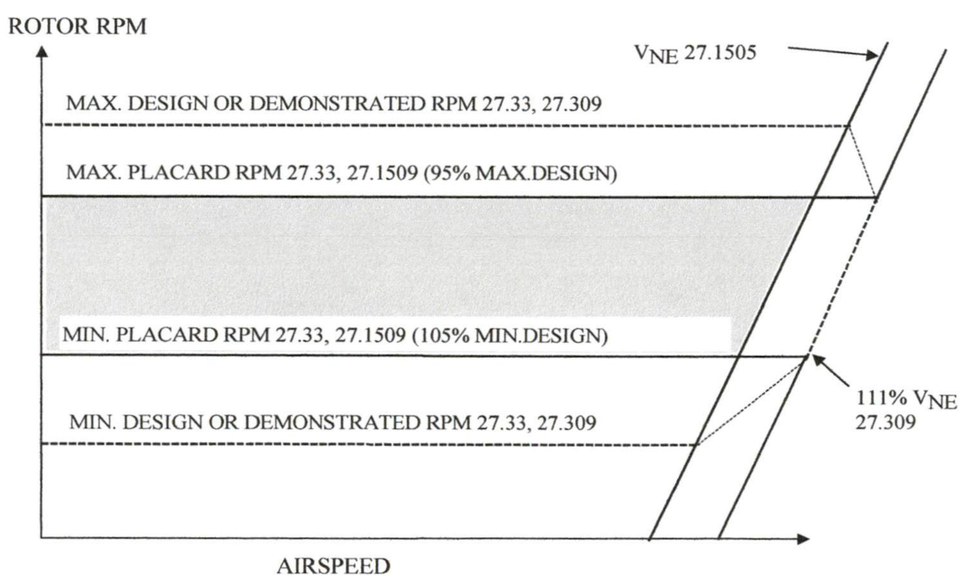


FIGURE AC 27.MG 11-3: Flight Regime to be Investigated for Power-Off Operation

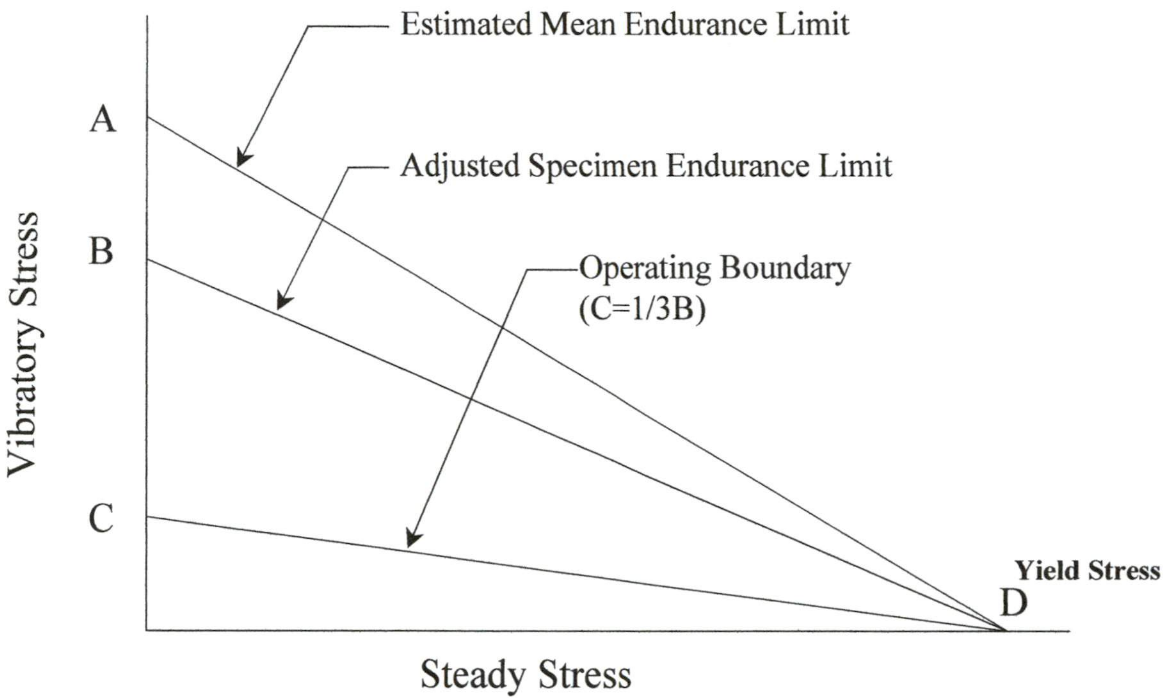


FIGURE AC 27.MG 11-4: Simplified analytical method for safe life evaluation

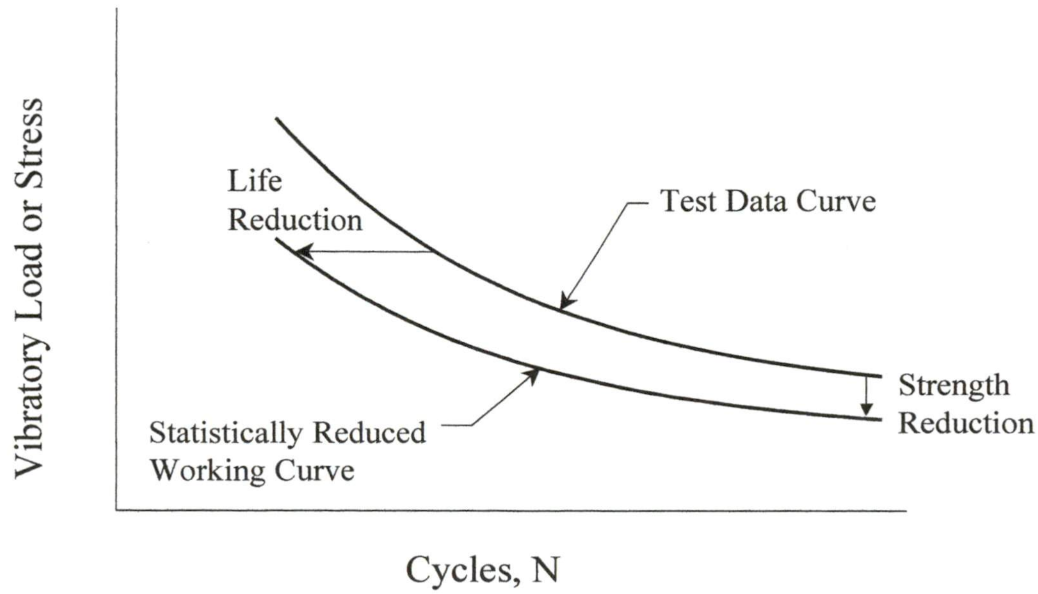


FIGURE AC 27.MG 11-5: Typical S/N curve for safe life evaluation.

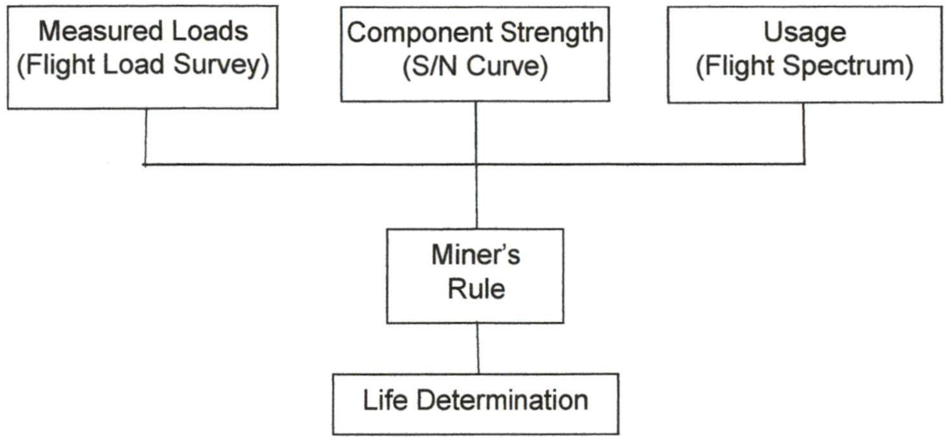


FIGURE AC 27.MG 11-6: Elements of Safe-Life Determination

FIGURE AC 27.MG 11-7

FLIGHT LOAD MEASUREMENT PROGRAM CONDITIONS TO BE INVESTIGATED

1. GROUND CONDITIONS.		
a. Normal start.		
b. Rapid increases of RPM on ground to maximum power-on RPM of main rotor.		
c. Taxiing with max allowable full cyclic control.		
d. Landing run (if applicable).		
e. Braking (if applicable).		
f. Normal shutdown.		
g. Special ground checks (if applicable).		
2. HOVERING IN AND OUT OF GROUND-EFFECT	(1) Steady with rotor at maximum side of RPM tolerance. (2) Steady with rotor at minimum side of RPM tolerance. (3) 90-degree right turn (4) 90-degree left turn (5) Control reversals (6) Sideward flight (7) Rearward flight	i) Longitudinal. ii) Lateral. iii) Rudder. i) Left. ii) Right.
3. MANEUVERING IN GROUND EFFECT	(1) Jump takeoff. (2) Normal takeoff (*) and accelerate to climb airspeed. (3) Normal Landing (*) (4) Full autorotational landing.	i) Multiengine. ii) One-engine-inoperative.

	FIGURE AC 27.MG 11-7 (continued)	
4. FORWARD FLIGHT-POWER ON. a. Level flight. (**)	(1) 40 percent V_H	i) Minimum side of main rotor RPM tolerance (RPM -) ii) Maximum side of main rotor RPM tolerance (RPM +)
	(2) 60 percent V_H	i) (RPM +) ii) (RPM -)
	(3) 80 percent V_H	i) (RPM +) ii) (RPM -)
	(4) V_H	i) (RPM +) ii) (RPM -)
	(5) V_{NE}	i) (RPM +) ii) (RPM -)
b. Maneuvers.	(1) Full power climbs. (**)	i) All engines operative. ii) One-engine-inoperative.
	(2) Cyclic pull-ups.	i) 60 percent V_H. ii) 90 percent V_H.
	(3) Normal acceleration from climb airspeed to 90 percent V_H.	
	(4) Turns, right and left over a range of bank angles and speeds up to the lesser of V_H or V_{NE} and including:	i) Right at 60 percent V_H and 90 percent V_H. ii) Left at 60 percent V_H and 90 percent V_H.
	(5) Control reversals at 90 percent V_H.	i) Longitudinal. ii) Lateral. iii) Rudder.
	(6) Deceleration from 90 percent V_H to descent airspeed.	
	(1) Partial power descent. (*)	
	(2) Normal approach	
	(3) Steep Approaches (to landing) or Flare	i) All engines. ii) One engine out.

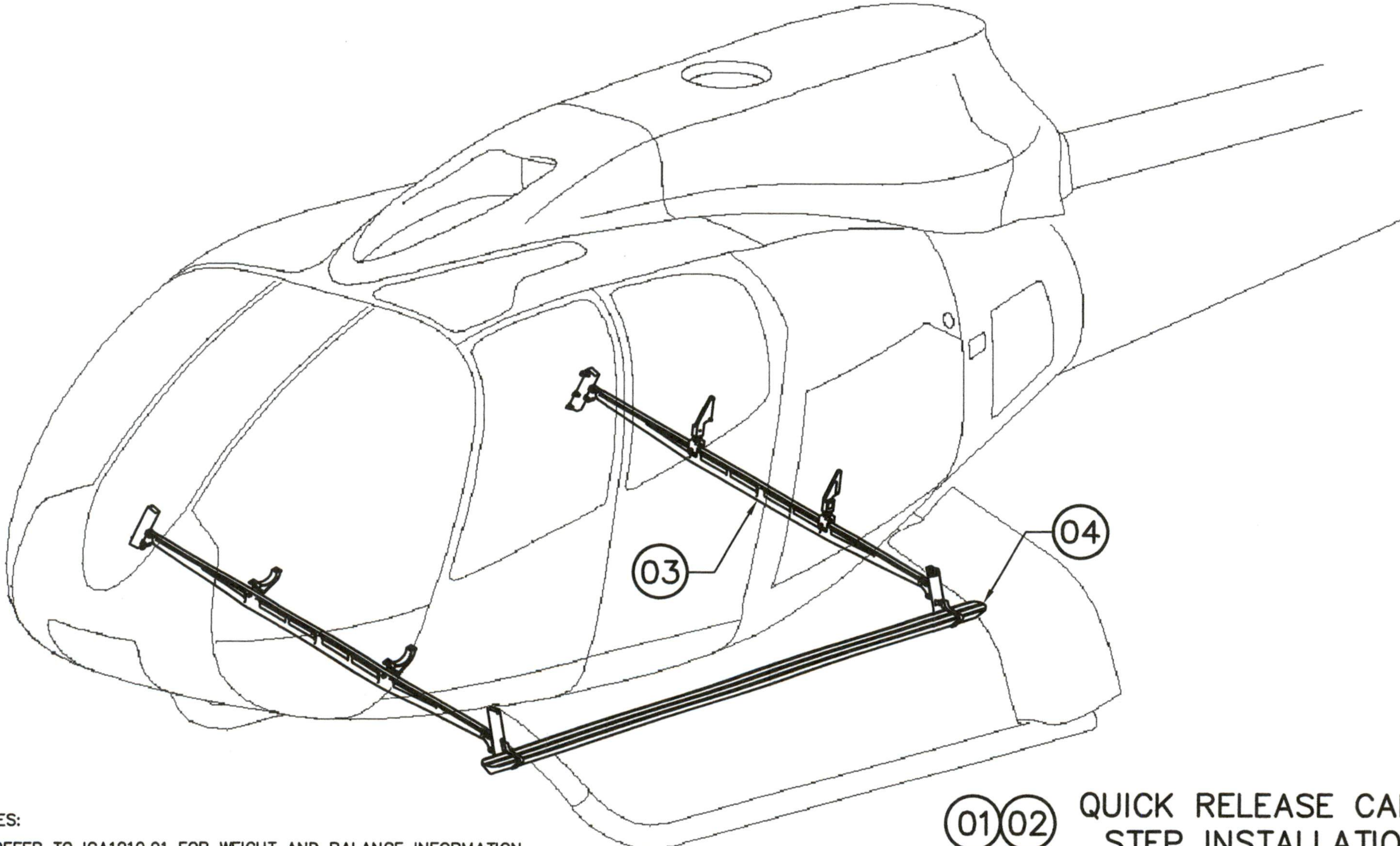
FIGURE AC 27.MG 11-7

	(continued)	
5. POWER TRANSITIONS. a. All engines operating to one engine out.	(1) In full power climb. (2) At 90 percent V_H.	
b. One engine out to all engines operating in powered descent.		
c. All engines operating to autorotation.	(1) At 60 percent V_H. (2) At maximum forward transition speed.	
d. Stabilized autorotation to all engines operating at normal autorotation airspeed.		
6. AUTOROTATION. a. Stabilized.	(1) At 70 percent V_{NE}. (2) At V_{NE}.	
b. Turns at 70 percent and 100 percent V_{NE}.	(1) Right. (2) Left.	
c. Cyclic pull-up.		
d. Control reversals.	(1) Longitudinal. (2) Lateral. (3) Rudder.	

(**) side slip conditions should be considered
(*) max slope angle and aircraft headings should be considered

FIGURE AC 27.MG 11-8

LIFTING HELICOPTER LOAD MEASUREMENT in addition to normal conditions		
CONDITION	%RATED LOAD	% V_{NE}
ROTOR START		
VERTICAL LIFT	100	
	87	
HOVER including spot turns sideward and rearward flight and control reversal.	100	
	87	
CRUISE with load	100	100
	87	100
	100	90
	87	90
CRUISE no load		100
		90
CLIMB max. rate		
DECELERATIONS max. rate		
GROUND IDLE SHUTDOWN		



(01)(02) QUICK RELEASE CABIN STEP INSTALLATION
LH SHOWN, RH OPPOSITE

NOTES:

1. REFER TO ICA1010.91 FOR WEIGHT AND BALANCE INFORMATION.
2. INSTALLATION INSTRUCTIONS:
   A. ENGAGE UPPER AFT ATTACHMENT FITTING INTO SLOT ON AFT MOUNTING BEAM.
   B. RAISE STEP AND ENGAGE LOWER AFT ATTACHMENT FITTING IN SLOT.
   C. SLIDE STEP AFT AND INSERT FORWARD ATTACHMENTS INTO FORWARD BEAM KEYWAYS.
   D. PUSH FORWARD END DOWN TO LOCK. PULL UP TO CHECK.

1	1	101010-01	04	CABIN STEP ASSEMBLY
1	1	100902-01	03	QUICK RELEASE MOUNTING BEAMS INSTALLATION
		101001-01-02	02	RH QUICK RELEASE CABIN STEP INSTALLATION
		101001-01-01	01	LH QUICK RELEASE CABIN STEP INSTALLATION
02	01	PART NO.	ITEM	DESCRIPTION
QTY	QTY	LIST OF MATERIALS		

APPROVALS	DATE
DRAWN: JEFF CLARKE	04 JUNE 2015
CHECKED: JASON REKVE	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.
TOLERANCES ON:

DECIMALS		ANGLES
X.XXX	±0.010	±1/2°
X.XX	±0.03	
X.X	±0.1	

AERO DESIGN LTD.
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AIRBUS HELICOPTERS EC130 B4
QUICK RELEASE CABIN STEP
CABIN STEP INSTALLATION

NOT TO SCALE	DWG. SIZE	DWG. NO.	REV.
SHEET 1 OF 1	A4	101001	0

FLIGHT TEST PLAN AND REPORT

FTP1009.03

AIRBUS HELICOPTERS EC130 B4

QUICK RELEASE CARGO BASKET

JASON REVIEWED – ok

Prepared by: J. Clarke, P.Tech.(Eng.)

Revision 0, 04 June 2015

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TABLE OF CONTENTS

1.0 INTRODUCTION

The Quick Release Cargo Basket is mounted on the right and/or left side of the helicopter. The basket is made from steel tubing and expanded steel mesh. It is quickly detachable from the mounting beams that support it.

2.0 REFERENCE TEXT

Aero Design Ltd. Installation Drawings

100901, Revision 0 – Cargo Basket Installation

100902, Revision 0 – Quick Release Mounting Provisions Installation

100903, Revision 0 – External Attachment Provisions Installation

101001, Revision 0 – Quick Release Cabin Step Installation

Aero Design Ltd. Flight Manual Supplement FMS1009.91 Revision 0 (draft)

Airbus Helicopters EC130 B4 Rotorcraft Flight Manual

3.0 FLIGHT TEST OBJECTIVE

Flight testing of the Quick Release Cargo Basket is meant to demonstrate the following:

- the installation is free of excessive vibration at speeds from hover thru to V_d;
- the installation does not produce undesirable effects to the handling and performance qualities of the helicopter;
- the airspeed system is not affected by the installation

This flight testing is in advance of flight testing by Transport Canada Flight Test Division in support of obtaining a Supplemental Type Certificate.

4.0 TEST PREPARATION

4.1 Instrument Calibration

The maintenance records of the test helicopter will be checked to ensure the airspeed indicator has been calibrated within the specified time period.

4.2 Equipment

1. The helicopter will be fitted with the Quick Release Mounting Provisions Installation in accordance with drawing 100902 and 100903 for the configurations specified in section 4.5.
2. The helicopter will be fitted with the Quick Release Cargo Basket Installation in accordance with drawing 100901 for the configurations specified in section 4.5.

3. The helicopter will be fitted with the Quick Release Cabin Step Installation in accordance with drawing 101001 on the side opposite to the cargo basket for the configurations specified in section 4.5.
4. The helicopter will be fitted with vibration analysis equipment, with at least one velocimeter located in/on the tail boom in accordance with standard procedures for performance of track and balance.
5. The helicopter will have a functional GPS to provide ground speed and track readings.

4.3 Flight Test Crew

Two crew members will be required for the test:

1) Pilot with training and experience appropriate to the task of testing this equipment.
2) Test observer, either a DAR or a qualified alternate, beside the pilot.

All members of the crew will be equipped to communicate via intercom.

Seating arrangement of the observer(s) may be limited by loading requirements.

4.4 Documents

These test flights require a FLIGHT PERMIT issued by Transport Canada. Flight permit must allow flight to 1.11 Vne.

The draft Flight Manual Supplement, FMS1009.91 Revision 0, shall be on board the aircraft.

The Pilot will familiarize himself with the contents of this Test Plan and the Flight Manual Supplement prior to flight.

4.5 Configuration

The helicopter will be loaded with sufficient fuel and ballast to produce the following conditions for flight:

A) Helicopter un-modified*, with weight and balance within limits specified in the flight manual

B) Cargo Basket configuration 100901-01-02 installed on the right hand side, basket loaded with 300 lbs; Cabin Step configuration 101001-01-01 installed on the left hand side.

C) Cargo Basket configuration 100901-01-01 installed on the left hand side, basket loaded with 300 lbs; Cabin Step configuration 101001-01-02 installed on the right hand side.

D) Cargo Basket configuration 100901-01-01 and 100901-01-02 installed on both sides, both baskets loaded with 300 lbs each.

*Note: The External Attachment Fittings Installation (100903) may be installed without the Quick Release Mounting Beams Installation (100902) for the unmodified flight.

C of G must remain within the limits specified in the Flight Manual. Similar longitudinal C of G and weight to be maintained for each flight.

Loading information specific to the Quick Release Cargo Basket is contained in the Flight Manual Supplement, FMS1009.91. The basket will be loaded with 300 lbs of lead shot in 25 lb bags, secured to prevent shifting in flight.

5.0 FLIGHT TESTS

5.1 Vibration and Handling Flights

These flights are intended to look for vibration and changes in the handling characteristics due to installation of the mounting provisions, cargo basket, and cabin step. One flight is required for each of the configurations listed in 4.5 above.

The flights are to be conducted as follows:

Take off and establish cruise at 50 kts. Increase speed in 10 kt increments up to Vne. Maneuver (turn, climb, descend) at different airspeeds. Recover from Vne, then accelerate to Vd (1.11 x Vne).

Vne as follows, refer to Flight Manual (Airbus Helicopters EC130 B4):

Vne = 155 KIAS at sea level, reduce by 3 knots per 1000 feet.

Vd = 1.11 x Vne = 172 KIAS at sea level

Record that each airspeed shows acceptable vibration and handling qualities by putting a check in each box in section 6.0. Record any observations. Record/include the vibration analysis output.

5.2 Airspeed System Check

The static port used for the airspeed indicator is located aft of the forward mounting beam on the bottom of the fuselage. This check is to determine if installation of the basket mounting provisions has affected the static system. If installation of the mounting provisions affects the static system it will cause the airspeed indicator to show inaccurate readings.

For configuration A and B, the indicated airspeeds will be checked against the GPS indicated ground speed, corrected for wind, at four different indicated airspeeds. The recorded values will be input into a spreadsheet that will account for windspeed and produce true airspeeds from the results. Differences between indicated airspeed and true airspeed indicates the mounting provisions have affected the pitot static system. Flight testing must not continue until the source of the error is resolved.

The flights are to be conducted as follows:

Stabilize flight at the specified airspeed and record the altitude, air temperature, GPS ground speed and track. Repeat at the same altitude for 2 additional headings, approximately 120 degrees apart, at the same indicated airspeed.

5.3 Other flights

Flight testing performed by a Transport Canada Flight Test Division Pilot may deviate from this test plan at the discretion of the test pilot in order to complete a Transport Canada prepared flight test report.

6.0 RECORDING OF RESULTS

Model: Airbus Helicopters EC130 B4

Serial Number: ________________

Registration: C-GUNL

Gross Weight: ________ lb

Results:

EC130 B4	Airspeed (KIAS)											
Configuration	50	60	70	80	90	100	110	120	130	140	Vne (155)	Vd (172)
A) Un-modified												
B) 100901-01-02 Basket (RH)												
C) 100901-01-01 Basket (LH)												
D) 100901-01-01 100901-01-02 Both Baskets												

Observations:

____

____

____

____

____

Flight test performed by: Date:

____

Airspeed Indicator Check:

Un-modified – Configuration A

Indicated Airspeed	Altitude	OAT	V_{gps} 1	Track 1	V_{gps} 2	Track 2	V_{gps} 3	Track 3	V_{true} (calculated)
50 KIAS									
80 KIAS									
100 KIAS									
120 KIAS									

Modified – Configuration B

Indicated Airspeed	Altitude	OAT	V_{gps} 1	Track 1	V_{gps} 2	Track 2	V_{gps} 3	Track 3	V_{true} (calculated)
50 KIAS									
80 KIAS									
100 KIAS									
120 KIAS									

TEST PLAN AND REPORT

TR1009.02

AIRBUS HELICOPTERS EC130 B4

QUICK RELEASE MOUNTING PROVISIONS AND CARGO BASKET INSTALLATION

LOAD TESTS

JASON REVIEWED - OK.

Prepared by: Jeff Clarke, P.Tech.(Eng.)

Revision 0, 20 May 2015

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TABLE OF CONTENTS

1.0 INTRODUCTION

This report documents the load tests used to demonstrate compliance with the structural requirements of the basis of certification.

2.0 REFERENCE TEXT

Engineering Report ER1009.01, Revision 0, 06 June 2015, Quick Release Mounting Provisions and Quick Release Cargo Basket – Compliance report

-Loads, section 4.0

Aero Design Ltd. Installation Drawings:

100901, Revision 0 – Cargo Basket Installation

100902, Revision 0 – Quick Release Mounting Beams Installation

100903, Revision 0 – External Attachment Provisions Installation

Aero Design Ltd. Fabrication Drawings:

100910, Revision 0 – Cargo Basket Assembly

100911, Revision 0 – Basket Body Assembly

94012, Revision 1 – Lid Assembly

100915, Revision 0 – Forward Beam Assembly

100916, Revision 0 – Aft Beam Assembly

100930, Revision 0 – Forward Fitting Fabrication

100931, Revision 0 – Aft Fitting Fabrication

100932, Revision 0 – Forward Beam Fabrication

100933, Revision 0 – Aft Beam Fabrication

100934, Revision 0 – Forward Down Tube Fabrication

100935, Revision 0 – Aft Down Tube Fabrication

3.0 LOADS

The loads are determined in Engineering Report ER1009.01, Revision 0. The summarized loads are below.

3.1 Combined Positive Maneuvering and Drag Load

Limit loads

P_{lim_man} = 1313 lbs	Limit positive maneuvering load (cargo and basket)
$P_{lim\_man\_test}$ = 1313 lbs – XX lbs	(basket applies 1g down – XX lbs)
$P_{lim\_man\_test}$ = XX lbs	Limit positive maneuvering load for test
$P_{lim\ drag}$ = 340 lbs	Limit drag load

Ultimate loads

P_{ult_man} = 1969 lbs	Ultimate positive maneuvering load (cargo and basket)
$P_{ult\_man\_test}$ = 1969 lbs – XX lbs	(basket applies 1g down – XX lbs)
$P_{ult\_man\_test}$ = XX lbs	Ult. positive maneuvering load for test
$P_{ult\ drag}$ = 510 lbs	Ultimate drag load

4.0 TEST SETUP

4.1 Test Articles

The tests will be performed using the following parts fabricated and assembled in accordance with their respective drawings:

100910-01 - Cargo Basket Assembly

100915-01 – Forward Beam Assembly

100916-01 – Aft Beam Assembly

100930-01 – Forward Fitting

100931-01 – Aft Fitting

Form AN B043 conformity inspection record will be completed by Aero Design Ltd. The basket will be available for inspection by Transport Canada.

4.2 Test Fixture

The tests are performed on a fixture that simulates the hardpoints on the helicopter, the forward landing gear attachments and aft fuel cell cross member.

The fixture consists of two large rectangular steel tubes (4" x 6" x 3/8" wall), each welded to a base plate (1/2"), with channels (C5x6.7) welded to the sides to provide mounting points for further fixtures specific to the aircraft to be simulated. Tabs (1/4" plate) are welded to the top of the tubes to install bracing as required to maintain rigidity. The fixtures are bolted down to inserts in the concrete floor.

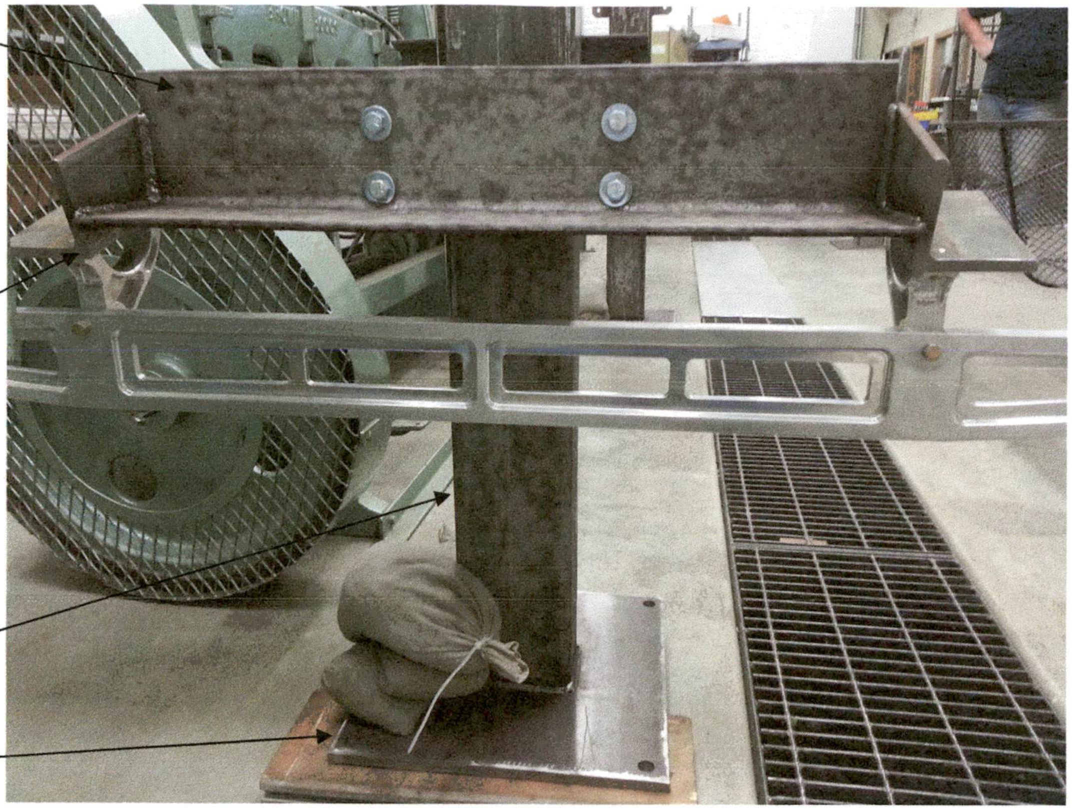

Figure 4.2.1 – Test Fixture – Looking aft at forward fixture

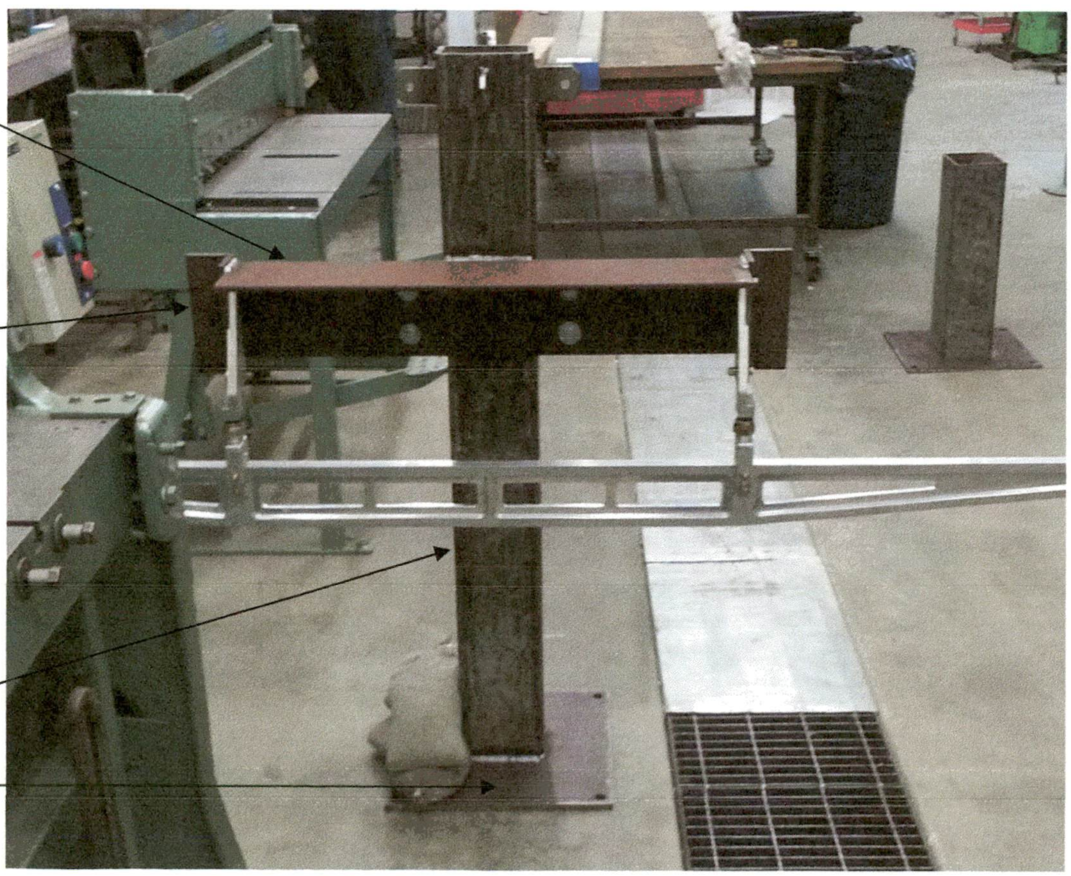

Figure 4.2.2 – Test Fixture – Looking aft at aft fixture

For this configuration, large steel angles (6" x 6" x 3/8") are used to locate smaller angles on the ends (4" x 4" x ½" forward; 3" x 3" x 3/8" aft) that simulate the airframe attachment points. The large angles are bolted to the channels on the tubes mentioned above with four ½" bolts.

The external attachment fittings are installed on the fixture in accordance with drawing 100903. The quick release mounting beams are installed on the external attachment fittings in accordance with drawing 100902. The cargo basket is installed on the quick release mounting beams in accordance with drawing 100901.

Aft Forward

Figure 4.2.3 – External Attachment Fittings and Quick Release Mounting Beams

Figure 4.2.4 – Test Setup – Looking down and aft

Figure 4.2.5 – Test Setup – Looking aft

To simulate drag, a fixture is installed on the aft end of the basket to pull aft directly on the last hoop, back to a post secured to the floor.

Figure 4.2.6 – Test Setup – Looking aft

4.3 Procedure

4.3.1 Combined Positive Maneuvering and Drag Load

1. Install the basket on the mounting beams. Open the lid. Attach drag fixture to aft hoop.
2. Apply the limit maneuvering load (?? lbs) downward using bags of lead shot, 25 lbs each, evenly distributed over the bottom of the basket. ?? bags are required (?? lbs).
3. Close the lid and latch the handle. Ensure correct functioning of handle latching.
4. Pull limit drag load (340 lbs) aft on fixture using a load cell and chain come-along.
5. The load must be applied for at least 3 seconds.
6. Document the test with pictures of the bags of lead shot stacked in the basket and of the overall test.
7. CAREFULLY release the drag load.
8. CAREFULLY open the lid. Keep feet clear of basket. Remove the load from the basket. Remove the basket from the mounting beams.
9. Visually inspect the basket, lid, hinge, handle and brackets, mounting beams and attachment fittings for signs of permanent deformation. Ensure correct functioning of handle latching.
10. Install the basket on the mounting beams. Open the lid. Attach drag fixture to aft hoop.
11. Apply the ultimate load (XX lbs) downward using bags of lead shot, 25 lbs each, evenly distributed over the bottom of the basket. XX bags are required (XX lbs).

    CAUTION: KEEP FEET CLEAR FROM UNDER BASKET.
12. CAREFULLY close the lid and latch the handle.
13. Pull ultimate drag load (510 lbs) aft on fixture using a load cell and chain come-along.
14. The load must be applied for at least 3 seconds.
15. Document the test with pictures of the bags of lead shot stacked on the lid and of the overall test.
16. CAREFULLY release the drag load.
17. CAREFULLY open the lid. Keep feet clear of basket. Remove the load from the basket. Remove the basket from the mounting beams.
18. Visually inspect the basket, lid, hinge, handle and brackets, mounting beams and attachment fittings for signs of permanent deformation or failure. Ensure correct functioning of handle latching.
19. Record the results in section 5.1 below.

5.0 TEST RESULTS

5.1 Positive Maneuvering Load

Tests witnessed by TCCA DAR 304 James Tinson on XX.

The positive maneuvering load tests were performed on basket assembly p/n 100910-01.

5.1.1 Limit Load

Condition	Required Load	Actual Load	Witness Initial
Limit Maneuvering Load (downward)	XX lbs (distributed over bottom)	lbs	
Limit Drag (aft)	340 lbs (pulled on aft hoop)	lbs	

(After completing the limit load test, the basket was removed from the mounting beams and the basket, mounting beams and attachment fittings were inspected for permanent or detrimental deformation. There was none found. The lid was opened and closed under load and the handle was checked for correct functioning, both performed normally, and were checked again after the load was removed, again performing normally.)

(picture)

Figure 5.1.3 – Limit Cargo Load

(picture)

Figure 5.1.4 – Limit Cargo Load

5.1.2 Ultimate Load

Condition	Required Load	Actual Load	Witness Initial
Ultimate Maneuvering Load (downward)	XX lbs (distributed over bottom)	lbs	
Ultimate Drag (aft)	510 lbs (pulled on aft hoop)	lbs	

The basket and mounts supported the ultimate positive maneuvering load for more than 3 seconds. The handle was checked for correct operation while under load.

Figure 5.1.3 – Ultimate Cargo Load

Figure 5.1.4 – Ultimate Cargo Load

ENGINEERING REPORT

ER1010.01

AIRBUS HELICOPTERS EC130

CABIN STEP INSTALLATION

COMPLIANCE REPORT

JASON REVIEWED - OK

Prepared by: Jeff Clarke, P.Tech.(Eng.)

Revision 0, 23 May 2015

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TABLE OF CONTENTS

1.0 INTRODUCTION

This report details the method of compliance for the paragraphs of AWM 527 listed in Certification Plan CP1009 related to the cabin step installation. It includes:

- generation of the applied loads to be used for the analysis and load testing used in the structural certification of the quick release cabin step
- analysis of reactions on the airframe

2.0 REFERENCE TEXT

Aero Design Ltd. Engineering Report ER969.01, Revision 0, dated 03 December 2012, approved by E. Burgoin, DAR 290M.

-Step extrusion load tested is same as used for this installation, test is valid for this configuration

Aero Design Ltd. Engineering Report ER1009.01, Revision 0

Aero Design Ltd. Test Report TR1009.02, Revision 0

Aero Design Ltd. Installation Drawing 101001, Revision 0

Aero Design Ltd. Fabrication Drawing 101010, Revision 0

3.0 DESCRIPTION

Installation of the Quick Release Mounting Provisions will require removal of the existing cabin step. When the helicopter will be operated without the cargo basket or installed equipment a step to access the cabin will be required.

The Quick Release Cabin Step is installed on the helicopter using the Mounting Provisions supplied for use with the Quick Release Cargo Basket. The step is an aluminum extrusion, with aluminum brackets welded near the ends with fittings that engage in the mounting beams. The step locks into the same mechanism on the mounting beams as the basket.

The step is similar to the cabin step used for the Bell 429, however the length is increased from 74.75" to 96".

4.0 LOADS

4.1 Load Factors

FAR 27.303 Safety Factor: $n_{sf} := 1.5$

FAR 27.337(a)

Limit Positive Maneuvering Load Factor: $n_{man} := 3.5$

$n_{man\_ult} := n_{man} \cdot n_{sf}$ Ultimate Positive Maneuvering Load Factor: $n_{man\_ult} = 5.25$

Limit Negative Maneuvering Load Factor: $n_{man\_neg} := -1.0$

$n_{man\_neg\_u} := n_{man\_neg} \cdot n_{sf}$ Ultimate Negative Maneuvering Load Factor: $n_{man\_neg\_u} = -1.5$

FAR 27.561(c)

Emergency Landing conditions do not apply. The step is not located above or behind the occupants of the cabin, and deflection or failure of the step does not endanger the occupants of the cabin.

FAR 27.625 Fitting Factor (does not apply to articles being tested): $n_{ff} := 1.15$

4.2 Maneuvering Load

The steps are not intended to be used in flight, therefore the maneuvering load factors do no apply to occupants of the step.
(check weight of step)

$W_{step} := 8.5 \cdot lbf$ Weight of step

Positive Maneuvering Load

$P_{man\_lim} := W_{step} \cdot n_{man\_lim}$

$P_{man\_lim} = 30\,lbf$ Limit maneuvering load due to step assembly

$P_{man\_ult} := P_{man\_lim} \cdot n_{sf}$

$P_{man\_ult} = 45\,lbf$ Ultimate maneuvering load due to step assembly

Negative Maneuvering Load

$P_{man\_lim\_neg} := W_{step} \cdot n_{man\_neg}$

$P_{man\_lim\_neg} = -9\,lbf$ Limit negative maneuvering load due to step assembly

$P_{man\_ult\_neg} := P_{man\_lim\_neg} \cdot n_{sf}$

$P_{man\_ult\_neg} = -13\,lbf$ Ultimate negative maneuvering load due to step assembly

4.3 Occupant Load

Load Case - 2 people at 2 g limit load factor

$P_{lim\_2} := 2 \cdot W_{person} \cdot 2$

$P_{lim\_2} = 800\text{lbf}$ Limit load due to 2 people

$P_{ult\_2} := P_{lim\_2} \cdot n_{sf}$

$P_{ult\_2} = 1200\text{lbf}$ Ultimate load due to 2 people

4.4 Aerodynamic Loads

4.4.1 Drag

$A_f := 12.0 \cdot \text{in}^2$ Frontal Area of step

$C_{Do} := 2.0$ Drag Coefficient of Step, (overestimated)

$\rho := 0.002378 \frac{\text{slug}}{\text{ft}^3}$ Density of air at Sea Level.

$V_{ne} := 155 \cdot \text{knots}$ Never-Exceed-Speed of EC130B4. (Ref. TCDS)

$V_d := \frac{V_{ne}}{0.9}$

$V_d = 172\text{knots}$ Design Dive Speed of EC130B4

$P_{drag\_lim} := \frac{\rho}{2} \cdot V_d^{\,2} \cdot A_f \cdot C_{Do}$

$P_{drag\_lim} = 17\text{lbf}$ Limit Drag load on step

$P_{drag\_ult} := P_{drag\_lim} \cdot n_{sf}$

$P_{drag\_ult} = 25\text{lbf}$ Ultimate Drag load on step

4.4.2 Lift

$A_{lift} := 108.75in \cdot 3.28 \cdot in$

$A_{lift} = 356.7in^2$ Planar Area of step

Coefficient of lift for round tubes relative to airflow varies from near 0 at 0 degree to 0.4 at about 60 degrees.

$C_L := 0.4$ Lift Coefficient of step (max for round tube at ~60 degrees)
Ref: Fluid-Dynamic Drag, Figure 18

$P_{lift\_lim} := \frac{\rho}{2} \cdot V_d^2 \cdot A_{lift} \cdot C_L$

$P_{lift\_lim} = 100lbf$ Limit lift load on step

$P_{lift\_ult} := P_{lift\_lim} \cdot n_{sf}$

$P_{lift\_ult} = 149lbf$ Ultimate lift load on step

5.0 STRUCTURAL COMPLIANCE

5.1 Step Assembly

Step assembly 101010-01 uses the same step extrusion as used on the Bell 429 configuration (P/N 96911-01), except the step length is increased from 74.75" to 96" between attachments. The Bell 429 step was tested to 1725 lbs without failure, reference ER969.01.

Considering the bending moment on the step in the test:

M = 1725 lbs * 74.75 in / 2

M = 64472 in-lbs Bending moment applied at centre of step assembly in test

The EC130 configuration places a significant section of the step aft of the cabin doors where it will not be occupied to load the cabin, which shifts the applied loads towards the forward attachment and reducing the bending moment applied to the step. To be conservative, it will be assumed the entire load from 2 people is applied at the centre of the step:

M = 1200 lbs * 96 in / 2

M = 57600 in- lbs Bending moment applied at centre of step assembly

The bending moment applied by two occupants acting at the centre of the step in the EC130 configuration does not exceed the bending moment demonstrated in the ultimate load test.

5.2 Fuselage Attachments

The quick release step uses the same attachments as the quick release cargo basket. The mounting beams have been demonstrated by test (ref: TR1009.02) to support a basket loaded with:

1313 lbs limit load without permanent deformation and

1969 lbs ultimate load without failure

These loads are greater than the applied loads from the step. Loads from the cargo basket are applied farther out than the step loads, so the bending moment due to the step is lower. Installation of the quick release step assembly is acceptable.

5.3 Aerodynamic Loads

The ultimate aerodynamic drag load of 25 lbs is small and by inspection can be carried by the step assembly and attachments to the helicopter.

The ultimate aerodynamic lift load of 149 lbs is relatively small compared to the personnel loading. By inspection, the extrusion can support this load without permanent deformation or failure. The attachments have been demonstrated to support a higher negative maneuvering load, see Engineering Report ER1009.01.

6.0 COMPLIANCE WITH FAR 27.251 – VIBRATION

Compliance with FAR 27.251 is demonstrated by test. The step assembly is installed on the flight test configurations specified in Flight Test Plan and Report FTP1009.03.

6.5 LATERAL CG

The tables below give the lateral CG positions for different weights and their moments with respect to the Y plane (positive dimensions on the right, negative dimensions on the left).

6.5.1 Crew and passengers (7 seats)

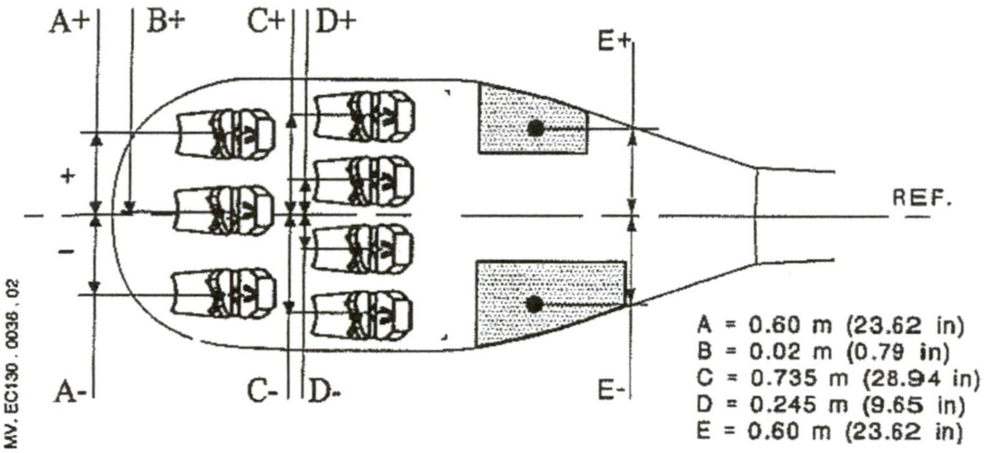


Figure 6 - 6 : Lateral location of seats and loads (7 seats)

METRIC UNITS									
WEIGHT	MOMENT : m.kg								
(kg)	A +	A -	B +	C +	C -	D+	D-	E +	E -
50	30	-30	1	36.75	-36.75	12.25	-12.25	30	-30
60	36	-36	1.2	44.1	-44.1	14.7	-14.7	36	-36
70	42	-42	1.4	51.45	-51.45	17.15	-17.15	42	-42
80	48	-48	1.6	58.8	-58.8	19.6	-19.6	48	-48
90	54	-54	1.8	66.15	-66.15	22.05	-22.05	54	-54
100	60	-60	2.0	73.5	-73.5	24.5	-24.5	60	-60
110	66	-66	2.2	80.85	-80.85	29.95	-29.95	66	-66
120	72	-72	2.4	88.2	-88.2	29.4	-29.4	72	-72
130	78	-78	2.6	95.55	-95.55	31.85	-31.85	78	-78
140	84	-84	2.8	102.9	-102.9	34.3	-34.3		-84
150	90	-90	3	110.25	110.25	36.75	-36.75		-90
155	93	-93	3.1	113.92	-113.92	37.97	-37.97		-93

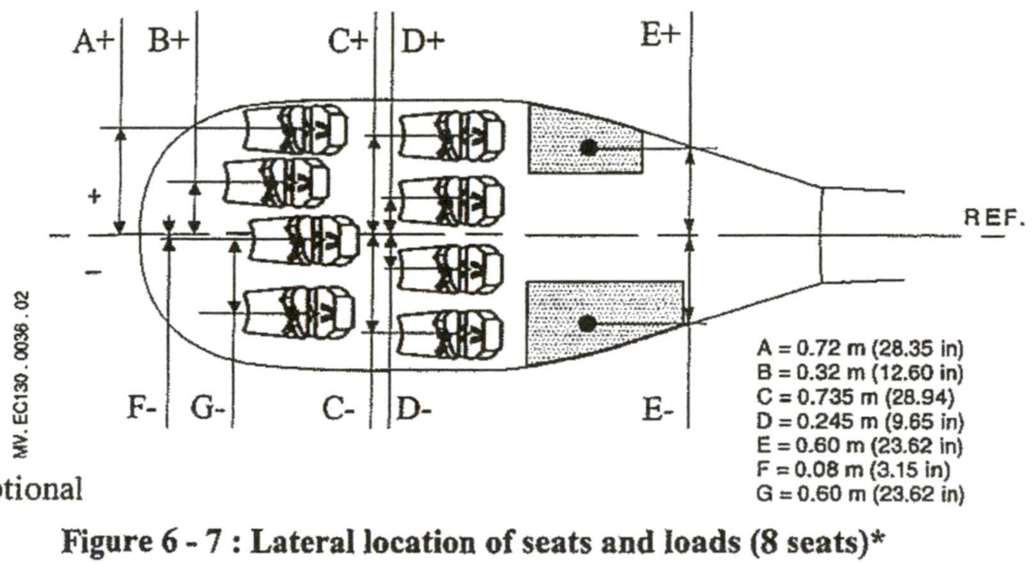
ANGLO-SAXON UNITS									
WEIGHT (lb)	MOMENT : in.lb								
	A +	A -	B +	C +	C -	D+	D-	E +	E -
50	1181	-1181	39	1447	-1447	482	-482	1181	-1181
75	1772	-1772	59	2170	-2170	723	-723	1772	-1772
100	2362	-2362	79	2894	-2894	965	-965	2362	-2362
125	2952	-2952	98	3617	-3617	1205	-1205	2952	-2952
150	3543	-3543	118	4340	-4340	1447	-1447	3543	-3543
175	4134	-4134	138	5064	-5064	1688	-1688	4134	-4134
200	4724	-4724	157	5787	-5787	1929	-1929	4724	-4724
220	5197	-5197	173	6366	-6366	2122	-2122	5197	-5197
264	6236	-6236	208	7639	-7639	2546	-2546	6236	-6236
275	6496	-6496	217	7958	-7958	2653	-2653	6496	-6496
287	6779	-6779	227	8306	-8306	2770	-2770	6779	-6779
300	7086	-7086	236	8681	-8681	2894	-2894		-7086
325	7677	-7677	256	9405	-9405	3135	-3135		-7677
342	8078	-8078	270	9897	-9897	3300	-3300		-8078

NOTE

The « central » front seats has a slight offset with the Y plane:

- left-hand pilot version : B+ = +0.02m (+0.79 in)

6.5.2 Crew and passengers (8 seats)*



* Optional

Figure 6 - 7 : Lateral location of seats and loads (8 seats)*

HUMAN POWERED VEHICLE PERFORMANCE

	DESCRIPTION	FORCES AT 20 MPH (POUNDS) Aerodynamic Pressure is about 1 LB/FT²	AERODYNAMIC DATA: DRAG COEFFICIENT C_D	AERODYNAMIC DATA: FRONTAL AREA (FT²) A	AERODYNAMIC DATA: EFFECTIVE FRONTAL AREA (FT²) C_DA	ROLLING RESISTANCE COEFFICIENT C_R	LEVEL GROUND, NO WINDS: HORSEPOWER REQUIRED AT 20 MPH AS A PERCENTAGE OF THE TOURING (ARMS STRAIGHT) BICYCLIST	LEVEL GROUND, NO WINDS: ALL DAY TOURING SPEED AT 0.1 HORSEPOWER OUTPUT (MPH)	LEVEL GROUND, NO WINDS: MAXIMUM SPEED WITH 1.0 HORSEPOWER OUTPUT (MPH)	EFFECT OF HILLS: STEADY SPEED UP A 5% GRADE AT 0.4 HORSEPOWER OUTPUT (MPH)	EFFECT OF HILLS: STEADY SPEED COASTING DOWN A 5% GRADE (MPH)
STANDARD BICYCLES	**BMX** (YOUTH OFF ROAD RACER) — 30 LB BIKE, 120 LB RIDER, 20" DIA 40PSI KNOBBY TIRES	AIR 5.52 2.10	1.1	4.9	5.4	.014	146%	10.1	27.8	12.2	19.8
STANDARD BICYCLES	**EUROPEAN** UPRIGHT COMMUTER — 40 LB BIKE, 160 LB RIDER, 27" DIA 40 PSI TIRES	AIR 6.14 1.20	1.1	5.5	6.0	.006	140%	11.3	27.6	10.9	24.0
STANDARD BICYCLES	**TOURING** (ARMS STRAIGHT) — 25 LB BIKE, 160 LB RIDER, 27" DIA 90 PSI CLINCHER TIRES	AIR 4.40 .83	1.0	4.3	4.3	.0045	100%	13.1	31.1	12.2	27.7
STANDARD BICYCLES	**RACING** (FULLY CROUCHED) — 20 LB BIKE, 160 LB RIDER, 27" DIA 105 PSI SEWUP TIRES	AIR 3.48 .54	.88	3.9	3.4	.003	77%	14.7	33.9	13.0	31.2
PROVED PRODUCTION	**AEROCOMPONENT** (FULLY CROUCHED) — 20 LB BIKE, 160 LB RIDER, 27" DIA 105 PSI SEWUP TIRES	AIR 3.27 .54	.83	3.9	3.2	.003	73%	15.0	34.6	13.0	32.2
PROVED PRODUCTION	**PARTIAL FAIRING** (ZZIPPER) CROUCHED — 21 LB BIKE, 160 LB RIDER, 27" DIA 105 PSI SEWUP TIRES	AIR 2.97 .54	.70	4.1	2.9	.003	67%	15.4	35.7	13.1	33.9
PROVED PRODUCTION	**RECUMBENT** (EASY RACER) — 27 LB BIKE, 160 LB RIDER, 27" REAR, 20" FRONT, 90 PSI CLINCHERS	AIR 2.97 .94	.77	3.8	2.9	.005	75%	14.4	35.2	12.5	33.7
PROVED PRODUCTION	**TANDEM** — 42 LB BIKE, TWO 160 LB RIDERS, 27" DIA 90 PSI CLINCHERS (181 LBS PER PERSON)	AIR 5.32 (2.66) 1.62 (.81)	1.0	5.2	5.2 (2.6 per person)	.0045	66%	15.2	36.6	13.0	35.2
	DRAFTING CLOSELY FOLLOWING ANOTHER BICYCLIST — 20 LB BIKE, 160 LB RIDER, 27" DIA 105 PSI SEWUP TIRES	AIR 1.94 .54	.50	3.9	1.9	.003	47%	17.5	41.0	13.6	41.7
RECORD HPV'S	**BLUE BELL** 2 WHEELED SINGLE RIDER — 40 LB BIKE, 160 LB RIDER, 27" REAR, 20" FRONT, 105 PSI SEWUPS	AIR .61 .80	.12	7.3 5.0	.6	.004	27%	22.5	58.6	12.9	77.4
RECORD HPV'S	**KYLE** 2 WHEELED TWO RIDERS — 52 LB BIKE, TWO 160 LB RIDERS, 105 PSI SEWUPS (186 LBS PER PERSON)	AIR 1.44 (.72) 1.12 (.56)	.2	7.0	1.4 (.7 per person)	.003	24%	23.3	56.6	14.0	69.9
RECORD HPV'S	**VECTOR SINGLE** TRIKE — 68 LB BIKE, 160 LB RIDER, SEWUPS 27" REAR, 24" FRONT	AIR .51 1.02	.11	4.56	.5	.0045	29%	21.8	61.2	11.3	90.1
RECORD HPV'S	**VECTOR TANDEM** TRIKE — 75 LB BIKE, TWO 160 LB RIDERS, 24" SEWUPS (198 LBS PER PERSON)	AIR .62 (.31) 1.78 (.89)	.13	4.7	.6 (.3 per person)	.0045	23%	25.6	72.5	13.0	108.4
...RETICAL LIMITS	**PERFECT BIKE** — NO ROLLING RESISTANCE, ZERO DRAG ON ENTIRE BIKE, DRAG OF HUMAN ONLY IN TOURING POSITION	AIR 3.07 0	.8	3.8	3.0	0	59%	16.7	35.9	13.4	34.7
...RETICAL LIMITS	**DRAGLESS HUMAN** — ZERO DRAG ON HUMAN, DRAG OF BIKE ONLY, ROLLING RESISTANCE INCLUDES HUMANS WEIGHT	AIR 1.33 .81	1.1	1.2	1.3	.0045	41%	18.4	45.8	13.3	50.3
...RETICAL LIMITS	**PERFECT RECUMBENT** — DRAG ON FLAT ON BACK HUMAN ONLY	AIR .72 0	.6	1.2	.7	0	14%	27.1	58.3	16.8	66.9
...RETICAL LIMITS	**PERFECT PRONE BIKE** — DRAG ON 109 LB SMALL BUT POWERFUL HUMAN ONLY	AIR .51 0	.6	.8	.5	0	10%	30.4	65.3	23.2	65.3
...RETICAL LIMITS	**PERFECT PRONE STREAMLINER**	AIR .07 0	.05	1.4	.07	0	1%	58.3	125.9	[illegible]5.6	174.5
TH...	**MOTOR PACED** — 42 LB BIKE, 160 LB RIDER (VEHICLE BREAKS AIR FOR RIDER), 70 PSI MOTORCYCLE ROAD RACING TIRES	AIR 0 1.21	—	—	VARIES WITH SPEED (MINUS OVER 100 MPH)	.006	23%	29.4	294.0	12.6	∞
TH...	**MOON BIKE** 1/6 g ENVIRONMENT — 25 LB BIKE, 160 LB RIDER, 15 LB SPACE SUIT, 27" DIA 90 PSI CLINCHERS	AIR 0 .15	—	—	0	.0045	3%	237.5	2.375.	78.4	∞

SOURCE

The Aerodynamics of Human-powered Land Vehicles

A bicycle and its rider are strongly impeded by their resistance to the flow of air. Aerodynamic stratagems have brought vehicles that can go 60 miles per hour on a level road without assistance

by Albert C. Gross, Chester R. Kyle and Douglas J. Malewicki

For decades the principles of aerodynamics have been applied with great success to improving the speed and efficiency of aircraft, automobiles, motorcycles and even competitive skiers and skaters. Vehicles powered by human energy, however, were virtually ignored until quite recently, which is strange in view of the fact that air resistance is by far the major retarding force affecting them. With a bicycle, for example, it accounts for more than 80 percent of the total force acting to slow the vehicle at speeds higher than 18 miles per hour. Here we undertake to explain this neglect and to show what attention to aerodynamics is beginning to do for the performance of human-powered land vehicles.

Looking first at the bicycle, one sees that it has remained almost the same in form for nearly a century. The Rover Safety Cycle, which was introduced in England in 1884, could easily pass for a modern bicycle; it lacks only a seat brace, which would have formed the modern diamond frame, and a few components such as brakes and multiple gears. Almost from the beginning the designers and users of bicycles recognized the importance of aerodynamics, but artificial constraints on design largely prevented the application of the necessary technology. It was as obvious then as it is now that wind forces at the bicycle-racing speed of from 20 to 30 m.p.h. are enormous.

Before 1900 the crouched posture of the bicycle racer had become common as a means of reducing air resistance. Another practice adopted before 1900 was to put a multiple-rider bicycle ahead of a single racer to shield him from the wind. In 1895 the Welsh wheelman Jimmy Michael rode 28.6 miles in one hour behind a four-man lead bicycle. In 1899 Charles ("Mile-a-Minute") Murphy of the U.S. gained international fame by pedaling one mile at 63.24 m.p.h. on a bicycle traveling behind a train of the Long Island Rail Road on a board path built for the occasion.

In 1912 Étienne Bunau-Varilla of France patented a streamlined enclosure for a bicycle and its rider that was inspired by the shape of the first dirigible balloons. Versions of this bicycle and its descendants set speed records in Europe from 1912 to 1933. In 1933 Marcel Berthet of France covered 31.06 miles in one hour riding a streamlined rig named the Vélodyne; his pace was more than 3 m.p.h. faster than anyone riding a standard bicycle had gone for one hour.

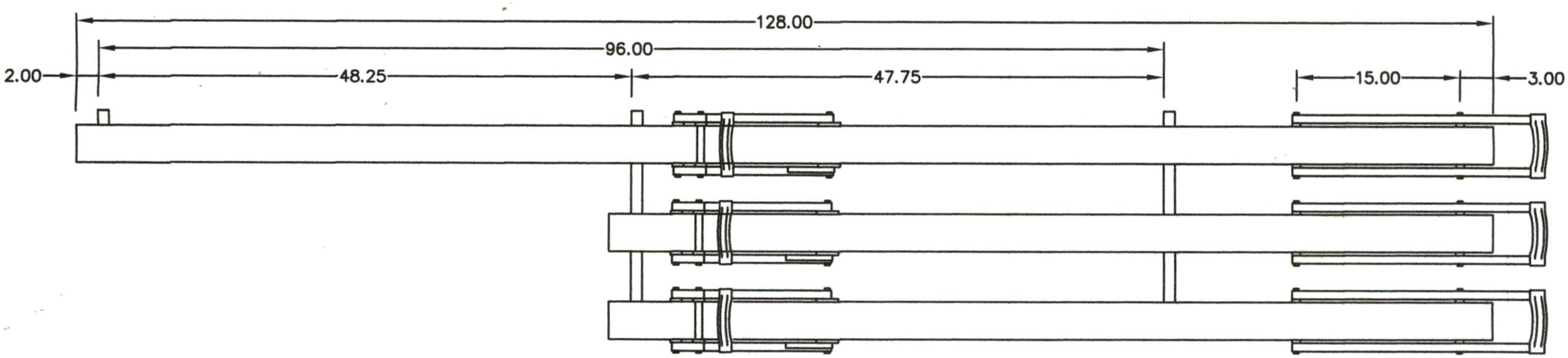
In the same year the French inventor Charles Mochet built a supine recumbent bicycle (with the rider pedaling while lying on his back) that he later streamlined. With a professional racer, François Faure, this "Vélocar" set a number of speed records between 1933 and 1938. Mochet and Faure hoped the records would be recognized by the Union Cycliste Internationale, the world governing body for bicycle racing. They were not.

Indeed, in 1938 the Union banned the use of aerodynamic devices and recumbent bicycles in racing; the rule is still in force. The ban has been a serious deterrent to the development of high-speed bicycles and is one of two major reasons the bicycle has remained nearly unchanged for so long. (The other reason is that in the developed countries the shift to the automobile has made the bicycle less important for transportation than it once was.)

By its ruling the Union essentially classified improvements in the aerodynamics of bicycles and other technological changes as "cheating." (It is perhaps fortunate that the Union was not active when a Scotch-Irish veterinary surgeon, John Boyd Dunlop, developed the pneumatic tire for bicycles in 1887, otherwise people might now be riding bicycles ar possibly automobiles with solid ste wheels.) To its credit, however, the U ion has gradually begun to relax its r strictions on changes in aerodynamic although recumbents are still forbi den. Since 1976 skintight one-piece su have become common in internatio al bicycle racing. Streamlined helme teardrop cross sections for frame tu ing, streamlined brake levers and oth aerodynamically improved componen have been allowed. In fact, technolog cal change in all forms of human-po ered vehicle is flourishing at a rate u matched since the heyday of the bicyc in the 19th century.

This rapid change can be partly attri uted to a series of events in Californ In 1973 one of us (Kyle) and Jack E Lambie, a consultant in aerodynami who was working independently, bu and tested the first two streamlined bic cles in the U.S. Unlike their predece sors, Kyle and Lambie actually me sured the reduction in drag achieved b streamlining. They did so by conductin numerous coast-down tests, in which a unpowered vehicle is allowed to dece erate on a level surface. In this conditio the deceleration of the vehicle is pro portional to the total retarding forc acting on it; instruments measure eithe the speed or the deceleration. Kyle an Lambie, publishing their results ind pendently, both concluded that the tot drag forces on a bicycle could be re duced by more than 60 percent with vertical, wing-shaped fairing that com pletely encloses the bicycle and the ric er. (It was not until some two years la er that either Kyle or Lambie learne that similar vehicles had been built ear lier in Europe.)

In 1974 Ronald P. Skarin, an Olympi cyclist for the U.S., set five world spee records riding the Kyle streamlined bi cycle at the Los Alamitos Naval Air Sta tion. Because of this success, Kyle an


128.00
96.00
2.00
48.25
47.75
15.00
3.00

Transport Canada / Transports Canada

DESIGN CHANGE APPROVAL APPLICATION / DEMANDE D'APPROBATION D'UNE MODIFICATION DE LA CONCEPTION

Legal name and address of applicant / Nom et adresse légal du demandeur	Legal name and address of prospective holder / Nom et adresse légal du titulaire éventuel	Name and address for billing purposes (if different than applicant) / Nom et adresse aux fins de facturation (si différent du demandeur)
Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	

Identification of aeronautical product / Identification du produit aéronautique

Make / Marque	Model / Modèle	Registration / Immatriculation	Serial No. / N° du série	Part No. / N° de la pièce
Airbus Helicopters	EC130B4/AS350/355	All eligible	All eligible	

Request for (check appropriate box) / Objet de la demande (Cochez les carrés selon le cas)

- [x] STC / CTS
- [ ] STC (single serial number) / CTS (numéro de série simple)
- [ ] STC (multiple serial numbers) / CTS (numéros de série multiples)
- [ ] Type Certificate Revision / Revision de certificat de type
- [ ] Revision / Révision — No. / N° ______ Current Issue / Édition active ______
- [ ] Repair Design Approval (RDA) / Approbation de la conception de réparation (ACR)
- [ ] Repair Design Approval - Process Repair / ACR - Processus de réparation
- [ ] Part Design Approval (PDA) / Approbation de la conception de pièce (ACP)

Type Design Examination by Foreign Authority / Examen de la définition de type par autorité étrangère

- [ ] Application to a foreign authority is requested / La demande à une autorité étrangère est demandée.
- [ ] Type design examination of foreign change / Examen de la définition de type modification étrangère

Identify / Identifier ______

- [ ] Restricted Category / Catégorie restreinte — Type of Operation / Type d'opération

Title and brief description of modification, repair or replacement part, including effects of changes (use additional pages if necessary). Refer to CAR 521.155(b)(i) for details.
Titre et brève description de la modification, de la réparation ou de la pièce de rechange, y compris les effets des changements (utiliser des feuilles supplémentaires si nécessaire). Référez-vous à RAC 521.155(b)(i) pour des détails.

Quick Release Bicycle Rack Installation - Installation of quick release bicycle rack on mounting provisions installed in accordance with STC SH08-16.

Applicable Type Certificate (TC) / Certificat de type (CT) pertinent

TC No. / N° de CT	Issue No. / N° de l'édition	Identify State of Design / Identifier l'état de conception
H-83, H-87	22, 9	EASA

The applicant is responsible for the control of product manufacture / Le demandeur est responsable du contôle de la fabrication du produit

- [x] Yes / Oui
- [ ] No / Non

If no, identify who is responsible / Si non, identifier qui est responsable ______

Documentation to be submitted / Documentation à soumettre	Applicant / Demandeur — Submitted / Soumis: Yes / Oui	No / Non
Proposed certification basis / Proposition de base de certification	✓	
Certification plan in accordance with CAR 521.155(d) / Plan de certification selon RAC 521.155(d)	✓	

Applicant's remarks / Remarques du demandeur

I hereby certify that the information contained herein is correct and complete. I agree to pay charges as prescribed in Part 1, Subpart 4 of the CARs (CAR 104-Charges).

Je certifie que les renseignements figurant ci-dessus sont exacts et complets. Je m'engage à payer les redevances prescrites à la sous-partie 4 de la partie I du RAC (sous-partie 104 du RAC - Redevances).

JEFF CLARKE [signature]	VICE PRESIDENT	2015-05-28
Name and Signature of Applicant / Nom et signature du demandeur	Title / Poste	Date (yyyy-mm-dd) / Date (aaaa-mm-jj)

Canada

Transport Canada / Transports Canada

DESIGN CHANGE APPROVAL APPLICATION

DEMANDE D'APPROBATION D'UNE MODIFICATION DE LA CONCEPTION

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Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	

Identification of aeronautical product / Identification du produit aéronautique

Make / Marque	Model / Modèle	Registration / Immatriculation	Serial No. / N° du série	Part No. / N° de la pièce
Airbus Helicopters	EC130 B4	All eligible	All eligible	

Request for (check appropriate box) / Objet de la demande (Cochez les carrés selon le cas)

- [x] STC / CTS
- [ ] STC (single serial number) / CTS (numéro de série simple)
- [ ] STC (multiple serial numbers) / CTS (numéros de série multiples)
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- [ ] Repair Design Approval (RDA) / Approbation de la conception de réparation (ACR)
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- [ ] Part Design Approval (PDA) / Approbation de la conception de pièce (ACP)

Current Issue / Édition active ____

Type Design Examination by Foreign Authority / Examen de la définition de type par autorité étrangère

- [ ] Application to a foreign authority is requested / La demande à une autorité étrangère est demandée.
- [ ] Type design examination of foreign change / Examen de la définition de type modification étrangère

Identify / Identifier ____

- [ ] Restricted Category / Catégorie restreinte — Type of Operation / Type d'opération

Title and brief description of modification, repair or replacement part, including effects of changes (use additional pages if necessary). Refer to CAR 521.155(b)(i) for details.
Titre et brève description de la modification, de la réparation ou de la pièce de rechange, y compris les effets des changements (utiliser des feuilles supplémentaires si nécessaire). Référez-vous à RAC 521.155(b)(i) pour des détails.

Quick Release Bicycle Rack Installation - Installation of quick release bicycle rack on mounting provisions installed in accordance with STC SH08-16.

Applicable Type Certificate (TC) / Certificat de type (CT) pertinent

TC No. / N° de CT	Issue No. / N° de l'édition	Identify State of Design / Identifier l'état de conception
H-83	22	EASA

The applicant is responsible for the control of product manufacture / Le demandeur est responsable du contôle de la fabrication du produit

- [x] Yes / Oui
- [ ] No / Non

If no, identify who is responsible / Si non, identifier qui est responsable ____

Documentation to be submitted Documentation à soumettre	Applicant / Demandeur Submitted / Soumis — Yes / Oui	No / Non
Proposed certification basis Proposition de base de certification	✓	
Certification plan in accordance with CAR 521.155(d) Plan de certification selon RAC 521.155(d)	✓	

Applicant's remarks / Remarques du demandeur

I hereby certify that the information contained herein is correct and complete. I agree to pay charges as prescribed in Part 1, Subpart 4 of the CARs (CAR 104-Charges).

Je certifie que les renseignements figurant ci-dessus sont exacts et complets. Je m'engage à payer les redevances prescrites à la sous-partie 4 de la partie I du RAC (sous-partie 104 du RAC - Redevances).

JEFF CLARKE [signature]
Name and Signature of Applicant / Nom et signature du demandeur

VICE PRESIDENT
Title / Poste

2015-05-27
Date (yyyy-mm-dd) / Date (aaaa-mm-jj)

LANDING GEAR ASSY

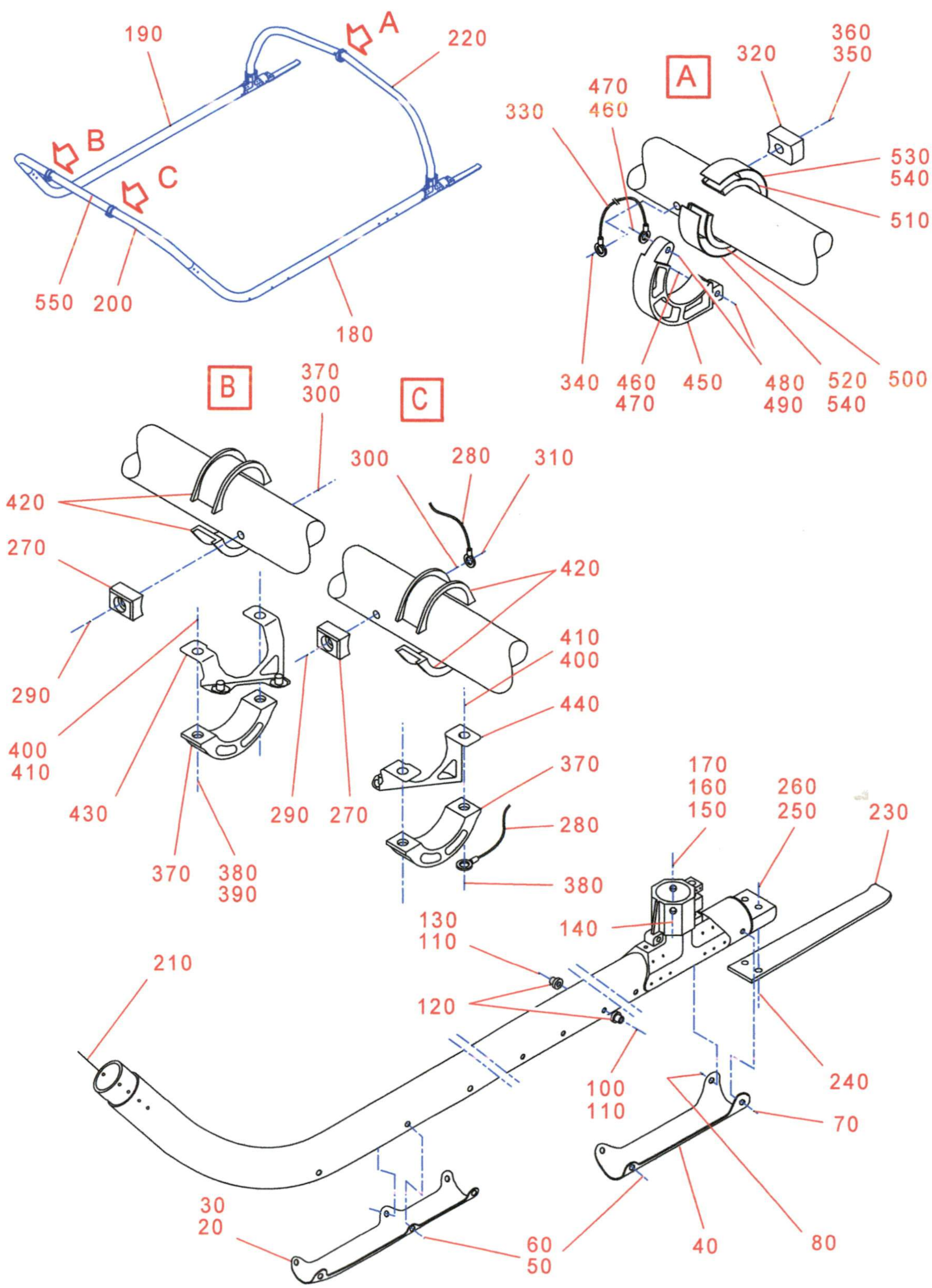


FIG.ITEM	CODE ENT. FSCM	MANUFACTURER PART NUMBER	DESCRIPTION 1234567	QTY ASSY	
01 - 1 For A/C : 3358 3363 3381-3382 3453 3470 3487 3490 3492 3498 3500 3506 3514-3515			LANDING GEAR ASSY FOR NHA SEE 32-10-10-01-20	REF	
20	F0210	350A41-0050-20	. PLATE, WEAR, FWR LH	1	
30	F0210	350A41-0050-21	. PLATE, WEAR, FWR RH	1	
40	F0210	350A41-0051-20	. PLATE, WEAR, AFT	2	
50	F0111	22125BC050014L	. SCREW	16	
60	F0111	23111AG050LE	. WASHER	16	
70	F0111	22201BC060090L	. SCREW	2	
80	F0111	23111AG060LE	. WASHER	2	R
100	F0111	22201BE120118L	. SCREW	6	
110	F5442	ASNA0265-120	. WASHER	12	
120	F0210	350A41-0052-20	. SPACER	12	
130	F5442	ASN52320BH120N	. NUT	6	
140	F0210	DHS411-101.3106	. SCREW	2	
150	F0111	23111AG100LE	. WASHER	2	
160	F5442	ASNA0045-100BCL	. NUT	2	
170	I9005	EN2367-18028	. PIN,SPLIT	2	
180	F0210	350A41-0045-00	. PAD,ASSY,LH SIDE	1	
190	F0210	350A41-0044-00	. PAD,ASSY,LH SIDE	1	
200	F0210	350A41-0042-20	. CROSS TUBE, FORWARD	1	
210	F5442	ASNA0027SB0605	. RIVET	24	
220	F0210	350A41-0058-20	. CROSS TUBE, REAR	1	
230	F0210	350A41-1076-20	. LEAF	2	
240	F0111	22252BE120042L	. SCREW	4	
250	F0111	23111AG120LE	. WASHER	4	
260	F5442	ASN52320BH120N	. NUT	4	
270	F0210	350A41-0048-20	. STOP, FWD	2	
280	F0210	993303-206-1	. BRAID,BONDING	1	
290	F0111	22201BE100096L	. SCREW	2	
300	F0111	23119AG100LE	. WASHER	2	
310	F5442	ASN52320BH100N	. NUT	2	
320	F0210	350A41-0062-20	. STOP, REAR	1	
330	F0210	993303-206-1	. BRAID,BONDING	1	
340	F0111	22201BE100092L	. SCREW	1	
350	F0111	23111AG100LE	. WASHER	1	
360	F5442	ASN52320BH100N	. NUT	1	
370	F0210	350A21-4483-20	. HALF CLAMP, FWD	2	
380	F0111	22201BE080016L	. SCREW	4	
390	F0111	23111AG080LE	. WASHER	3	

French standards
(8mm) dia
finish (cad)
NF L22-201 BE 080 016 L
type
mat'l
length (16mm)
?

400	97393	SL50M8A	. NUT	4
410	97393	SLR50M8B	. SPRING	4
420	F0210	350A41-0054-20	. HALF-BEARING,FORWARD,LOWER	4
430	F0210	350A21-4058-00	. SUPPORT	1
440	F0210	350A21-4058-01	. SUPPORT	1
450	F0210	350A21-4307-20	. CLAMP	1
460	F0210	DHS411-101.3038	. SCREW	2
470	F0111	23142AG100LE	. WASHER	2
480	F5442	ASNA0044-100BCL	. NUT	2
490	F0111	23310CA020025	. PIN,SPLIT	2
500	F0210	350A41-0060-20	. HALF-BEARING,REAR,LOWER	1
510	F0210	350A41-0059-20	. HALF-BEARING,UPPER,REAR	1
520	F0210	350A41-0064-20	. SHIM, LOWER	1
530	F0210	350A41-0063-20	. SHIM, UPPER	1
540	F0210	DHS171-143.20	. ADHESIVE,BOX 1 LITER	AR
550	F0210	ECS2033.32	. LABEL	1

- ITEM NOT ILLUSTRATED

Table 1-Torque values applied in "dry" condition (in metre-decanewtons (m.daN)

These torque values apply to ISO M and ISO MJ hardware.

Threads		With hexagonal nut Cadmium-plated steel bolt				With self-locking nut Cadmium-plated steel bolt			
Diameter	Pitch	35 NC6 TS : 880-1080Mpa		30 NCD 16 TS : 1080-1220Mpa		35 NC 6 TS : 880-1080Mpa		30 NCD 16 TS : 1080-1220Mpa	
		min.	max.	min.	max.	min.	max.	min.	max.
4	0.7	0.2	0.25	0.25	0.3	0.25	0.3	0.3	0.35
5	0.8	0.3	0.4	0.4	0.5	0.4	0.5	0.5	0.6
6	1	0.6	0.75	0.75	0.9	0.75	0.9	0.9	1.1
7	1	1	1.25	1.25	1.50	1.25	1.50	1.50	1.75
8	1 and 1.25	1.5	1.9	1.9	2.3	1.9	2.3	2.3	2.7
10	1.25 and 1.50	3.4	4.1	4.1	4.8	4.1	4.8	4.8	5.5
12	1.25 and 1.50	6.3	7.5	7.3	8.5	7.3	8.5	8.3	9.5
14	1.50	10	12	11.5	13.5	11.5	13.5	13	15
16	1.50	16	19	18	21	18	21	20	23

NOTE : For Nylstop and slotted nuts, the torque loading value is determined by the Design Office and noted on work cards.

NOTE : "Dry" condition means without lubricant (or sealing compound) on the threads or bearing surfaces.
The use of such products requires the application of a compensating coefficient to the "dry" values : see para. 1.7.

Table 2 : Torque values applied in "dry" condition for ISO bolts and nuts (inch) in metre-decanewtons (m.daN).

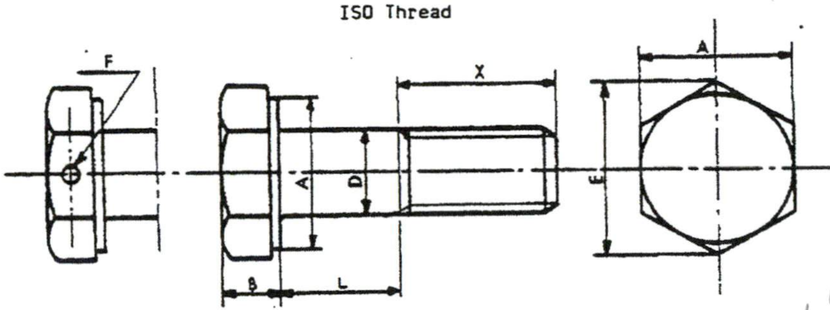
NOTE : Application requirements are the same for BNAE standard metric bolts.

THREADS		STANDARD NUTS				SELF-LOCKING NUTS			
		STEEL BOLT				STEEL BOLT			
Diameter	Qty of threads per inch	35 NC 6 TS : 88 hbar YS 0.002 73 hbar		30 NCD 16 TS :108 hbar YS 0.002 88 hbar		35 NC 6 TS : 88 hbar YS 0.002 73 hbar		30 NCD 16 TS : 108 hbar YS 0.002 88 hbar	
		mini.	maxi.	mini.	maxi.	mini.	maxi.	mini.	maxi.
.190 (No.10)	32	0.30	0.40	0.40	0.50	0.40	0.50	0.50	0.60
.2500 (1/4)	28	0.70	0.90	0.90	1.10	0.90	1.10	1.10	1.30
.3125 (5/16)	24	1.60	2.00	2.00	2.50	1.80	2.20	2.20	2.70
.3750 (3/8)	24	2.70	3.50	3.30	4.00	3.00	3.80	4.00	5.00
.4375 (7/16)	20	4.50	5.50	5.50	7.00	5.20	6.30	6.70	8.00
.5000 (1/2)	20	7.30	8.50	8.50	10.00	8.00	9.50	9.50	11.50
.5625 (9/16)	18	10.50	12.50	11.50	13.50	11.50	13.50	14.00	16.00
.6250 (5/8)	18	14.00	16.00	17.00	20.00	16.00	19.00	19.00	22.00
.7500 (3/4)	16	24.00	28.00	28.00	32.00	27.00	31.00	32.00	37.00

SCREW

22201
22202

ISO Thread



1080/1280 MPa

156/185 ksi

tension
8mm 8590 (160 ksi)
9660 (180 ksi)

AR-MMPS-01

22201 : Without locking hole

22202 : With locking hole

D	Pitch	A	B	E	F	L min.	X L<30	X L>30
5	0,8	8	2,8	8,8	1,2	3	8,5	9,5
6	1	10	3,2	11,1	1,5	4	9,5	10,5
7	1	11	3,5	12,2	1,5	4	10	11
8	1,25	13	4	14,5	1,8	5	11,5	12.5
10	1,5	17	4,5	19	1,8	7	13,5	14.5
12	1,5	19	4,2	21,3	2	9	15,5	16.5
14	1,5	22	6	24,7	2	11	17	18
16	1,5	24	7	26,9	2	13	19	20
18	1,5	27	8	30,3	2	15	20	21
20	1,5	30	9	33,7	2	17	21	22

Length L available in 1mm increments up to 30 ; in even numbers of mm from 30 onwards

MATERIAL	CODE	SURFACE TREATMENT	CODE
Steel 35NC6	BC	Cadmium plating	M
Steel 35NCD16	BZ	Cadmium plating	L
Titanium T-A6V	BE	Phosphatizing of anodizing + MOS2 varnish all over	X
Z10CNT18-11, non magnetic, passivated T.S. 490			
Z10CNT18-11, non magnetic, passivated T.S. 540			

PROCUREMENT

Every standard part shall be identified by its reference only

22201 BC 050 040 L
22202 BC 050 040 L

Material code
Diameter in 0,1 mm
Surface treatment code
Length in mm

Example

Manufacturer NATO code F0111

BE = 35CD4 Steel

Not Titanium

MATERIALS CODE

Meaning of the first two characters of the materials code for bolts and nuts and related items of chapter 3.

CAUTION

This appendix defines the materials code only. Concerning the selection of the materials, strictly comply with the material indicated in the references given in the illustrated parts catalog.

CODE	STANDARD DESCRIPTION	PROPERTIES min. T.S. (MPa)

A - Non alloyed steels

AA	A33	
AC	A37	
AD	XC 10 oder 12	
AD	XC18S	
AE	A50	
AE	XC32	
AG	XC38	
AJ	XC65	830
AK	XC75	1570
AM	XC75	

B - Alloyed steels

BA	35NC6	Annealed
BB	25CD4	
BC	35NC6	880
BD	25CD4S	
BE	30NCD16	
BE	35CD4	
BF	35CD4S	
BG	15CDV6	
BJ	28CDV5	
BM	Z2NKD18.8	

C - Stainless steels

CA	Z2CN18.10	440
CC	Z10CNT18.11	540
CC	Z10CN18.12	
CC	Z12CN18.10	540
CD	Z10CNT18.11	980
CF	Z15CN17.03	880
CH	Z30C13	880
CJ	Z10CNWT17.13	540
CM	EZ6CNT25	880
CN	Z50NMC12	830

CODE	STANDARD DESCRIPTION

D - Aluminium alloy

DA	A5
DB	AG5
DB	AG5MC
DC	AU2G
DE	AU4G
DF	AU4GA5
DG	AU4G1
DH	AU4G1A5
DJ	AZ5GU

T - Nickel alloy

T - Titanium alloy

TB	NU30
TC	NC15Fe
TD	NC20K14
TK	TA4M
TK	TA6V

U - Copper alloy

UA	U6C
UB	UZ39Pb2
UB	UZ36
UB	UZ36Pb2
UC	U4C
UD	UZ36
UD	UZ36
UD	UZ33
UF	UZ45N15
UG	UA10N
UJ	UBe2
UH	UZ9N26
UH	UZ16N25

SURFACE TREATMENTS CODE

Meaning of the 3rd character of materials and surface treatment code.

CAUTION

This table defines the surface treatment code for standard parts of chapter 3 only.

CODE	SURFACE TREATMENT			MATERIAL	USE EXAMPLE
A	In sulphuric bath Anodic oxidizing	with dichromate sealing		Aluminium alloy	For common use
B		with dicrhomate + MoS_2 sealing			Anti-seizing protection
C		with black coloring		AL alloy CU Ni alloy	Cabin bolts and nuts
D		in chromic bath		AL alloy	
E	Silver plating	Thickness : 6 to 10 μm		Low alloyed steel alloy	Hot anti-seizing protection
				Martensitic stainless steels	Hot anti-seizing and dry friction protection
		Thickness : 3 to 7 μm		Austenitic stainless steel	
F	Electrolytic nickel plating thick : 5 μm min.			Copper alloy	Bolts and nuts for electrical equipment
G	Molybdenum disulphide (MoS_2) applied as a suspension in polymerized fluid or hot dried			All metals	Anti-seizing protection
J	Chromating (chemical treatment in chromic bath)			Aluminium alloy	Anti-seizing protection
K	Decorative chromium plating (Cr 0.5 μm/Ni 5 μm)			All metals excluding titanium	
L	Cadmium plating	Thickness 7 μm	Chromic finish		For common use
LE		Thickness 10 μm			Reinforced protection

SURFACE TREATMENTS CODE

CODE	SURFACE TREATMENT		MATERIAL	USE EXAMPLE
M	Cadmium plating	Thickness 7 μm except on greased ground surfaces	Chromic finish	For accurate fitting
ME		Thickness 10 μm except on greased ground surfaces		For accurate fitting and reinforced protection
N		+ MoS_2		Anti-seizing protection
P	Tin plating		Cu alloy Carbon steel	Lockwire, washers for electrical equipment
Q	Cadmium nickel diffused		Steels exclusing stainless steel	For temperature $\leq$ 500°C
T	Phosphatatizing	Normal : 5 to 15 μm oily finish	Steel	Cabin bolts and nuts when cadmium plating is not permissible
U		Thin : 3 to 7 μm		
V	Sulphur case hardening		Steel	Friction parts
X	Anti friction corrosion treatment		Titanium	
Z	Zinc plating		Steel Cu alloy	Wires for cables

Transport Canada / Transports Canada

DESIGN CHANGE APPROVAL APPLICATION / DEMANDE D'APPROBATION D'UNE MODIFICATION DE LA CONCEPTION

Legal name and address of applicant / Nom et adresse légal du demandeur	Legal name and address of prospective holder / Nom et adresse légal du titulaire éventuel	Name and address for billing purposes (if different than applicant) / Nom et adresse aux fins de facturation (si différent du demandeur)
Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	

Identification of aeronautical product / Identification du produit aéronautique

Make / Marque	Model / Modèle	Registration / Immatriculation	Serial No. / N° du série	Part No. / N° de la pièce
Airbus Helicopters	EC130 B4	All eligible	All eligible	

Request for (check appropriate box) / Objet de la demande (Cochez les carrés selon le cas)

- [ ] STC / CTS
- [ ] STC (single serial number) / CTS (numéro de série simple)
- [ ] STC (multiple serial numbers) / CTS (numéros de série multiples)
- [ ] Type Certificate Revision / Revision de certificat de type
- [x] Revision / Révision — No. / N° SH08-16 — Current Issue / Édition active 5
- [ ] Repair Design Approval (RDA) / Approbation de la conception de réparation (ACR)
- [ ] Repair Design Approval - Process Repair / ACR - Processus de réparation
- [ ] Part Design Approval (PDA) / Approbation de la conception de pièce (ACP)

Type Design Examination by Foreign Authority / Examen de la définition de type par autorité étrangère

- [ ] Application to a foreign authority is requested / La demande à une autorité étrangère est demandée.
- [ ] Type design examination of foreign change / Examen de la définition de type modification étrangère

Identify / Identifier

- [ ] Restricted Category / Catégorie restreinte — Type of Operation / Type d'opération

Title and brief description of modification, repair or replacement part, including effects of changes (use additional pages if necessary). Refer to CAR 521.155(b)(i) for details.
Titre et brève description de la modification, de la réparation ou de la pièce de rechange, y compris les effets des changements (utiliser des feuilles supplémentaires si nécessaire). Référez-vous à RAC 521.155(b)(i) pour des détails.

External Cargo Basket, Cabin Steps Installation - Installation of mounting provisions on the fuselage; installation of quick release cargo basket or cabin step on mounting provisions

Applicable Type Certificate (TC) / Certificat de type (CT) pertinent

TC No. / N° de CT	Issue No. / N° de l'édition	Identify State of Design / Identifier l'état de conception
H-83	22	EASA

The applicant is responsible for the control of product manufacture / Le demandeur est responsable du contôle de la fabrication du produit

- [x] Yes / Oui
- [ ] No / Non — If no, identify who is responsible / Si non, identifier qui est responsable

Documentation to be submitted / Documentation à soumettre	Applicant / Demandeur — Submitted / Soumis: Yes / Oui	No / Non
Proposed certification basis / Proposition de base de certification	✓	
Certification plan in accordance with CAR 521.155(d) / Plan de certification selon RAC 521.155(d)	✓	

Applicant's remarks / Remarques du demandeur

Revision is to add EC130 B4 configuration

I hereby certify that the information contained herein is correct and complete. I agree to pay charges as prescribed in Part 1, Subpart 4 of the CARs (CAR 104-Charges).

Je certifie que les renseignements figurant ci-dessus sont exacts et complets. Je m'engage à payer les redevances prescrites à la sous-partie 4 de la partie I du RAC (sous-partie 104 du RAC - Redevances).

JEFF CLARKE [signature]	VICE PRESIDENT	2015-05-12
Name and Signature of Applicant / Nom et signature du demandeur	Title / Poste	Date (yyyy-mm-dd) / Date (aaaa-mm-jj)

Canada

Transport Canada | Transports Canada

DESIGN CHANGE APPROVAL APPLICATION
DEMANDE D'APPROBATION D'UNE MODIFICATION DE LA CONCEPTION

Legal name and address of applicant / Nom et adresse légal du demandeur	Legal name and address of prospective holder / Nom et adresse légal du titulaire éventuel	Name and address for billing purposes (if different than applicant) / Nom et adresse aux fins de facturation (si différent du demandeur)
Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	

Identification of aeronautical product / Identification du produit aéronautique

Make / Marque	Model / Modèle	Registration / Immatriculation	Serial No. / N° du série	Part No. / N° de la pièce
Airbus Helicopters	EC130 B4	All eligible	All eligible	

Request for (check appropriate box) / Objet de la demande (Cochez les carrés selon le cas)

- ☐ STC / CTS
- ☐ STC (single serial number) / CTS (numéro de série simple)
- ☐ STC (multiple serial numbers) / CTS (numéros de série multiples)
- ☐ Type Certificate Revision / Revision de certificat de type
- ☑ Revision / Révision — No. / N° SH08-16 — Current Issue / Édition active 5
- ☐ Repair Design Approval (RDA) / Approbation de la conception de réparation (ACR)
- ☐ Repair Design Approval - Process Repair / ACR - Processus de réparation
- ☐ Part Design Approval (PDA) / Approbation de la conception de pièce (ACP)

Type Design Examination by Foreign Authority / Examen de la définition de type par autorité étrangère

- ☐ Application to a foreign authority is requested / La demande à une autorité étrangère est demandée.
- ☐ Type design examination of foreign change / Examen de la définition de type modification étrangère

Identify / Identifier

☐ Restricted Category / Catégorie restreinte — Type of Operation / Type d'opération

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Quick Release Bicycle Rack Installation - Installation of quick release bicycle rack on mounting provisions installed in accordance with STC SH08-16

Applicable Type Certificate (TC) / Certificat de type (CT) pertinent

TC No. / N° de CT	Issue No. / N° de l'édition	Identify State of Design / Identifier l'état de conception
H-83	22	EASA

The applicant is responsible for the control of product manufacture / Le demandeur est responsable du contôle de la fabrication du produit

☑ Yes / Oui ☐ No / Non — If no, identify who is responsible / Si non, identifier qui est responsable

Documentation to be submitted / Documentation à soumettre	Applicant / Demandeur Submitted / Soumis — Yes / Oui	No / Non
Proposed certification basis / Proposition de base de certification	✓	
Certification plan in accordance with CAR 521.155(d) / Plan de certification selon RAC 521.155(d)	✓	

Applicant's remarks / Remarques du demandeur

Revision is to add EC130 B4 configuration

I hereby certify that the information contained herein is correct and complete. I agree to pay charges as prescribed in Part 1, Subpart 4 of the CARs (CAR 104-Charges).

Je certifie que les renseignements figurant ci-dessus sont exacts et complets. Je m'engage à payer les redevances prescrites à la sous-partie 4 de la partie I du RAC (sous-partie 104 du RAC - Redevances).

JEFF CLARKE Jeff Clarke. — Name and Signature of Applicant / Nom et signature du demandeur

VICE PRESIDENT — Title / Poste

2015-05-12 — Date (yyyy-mm-dd) / Date (aaaa-mm-jj)

For A/C : All

General Description

A. Introduction

The external lighting system is used to indicate the position of the helicopter and to light up the approach and landing area.

The external lighting system consists of:

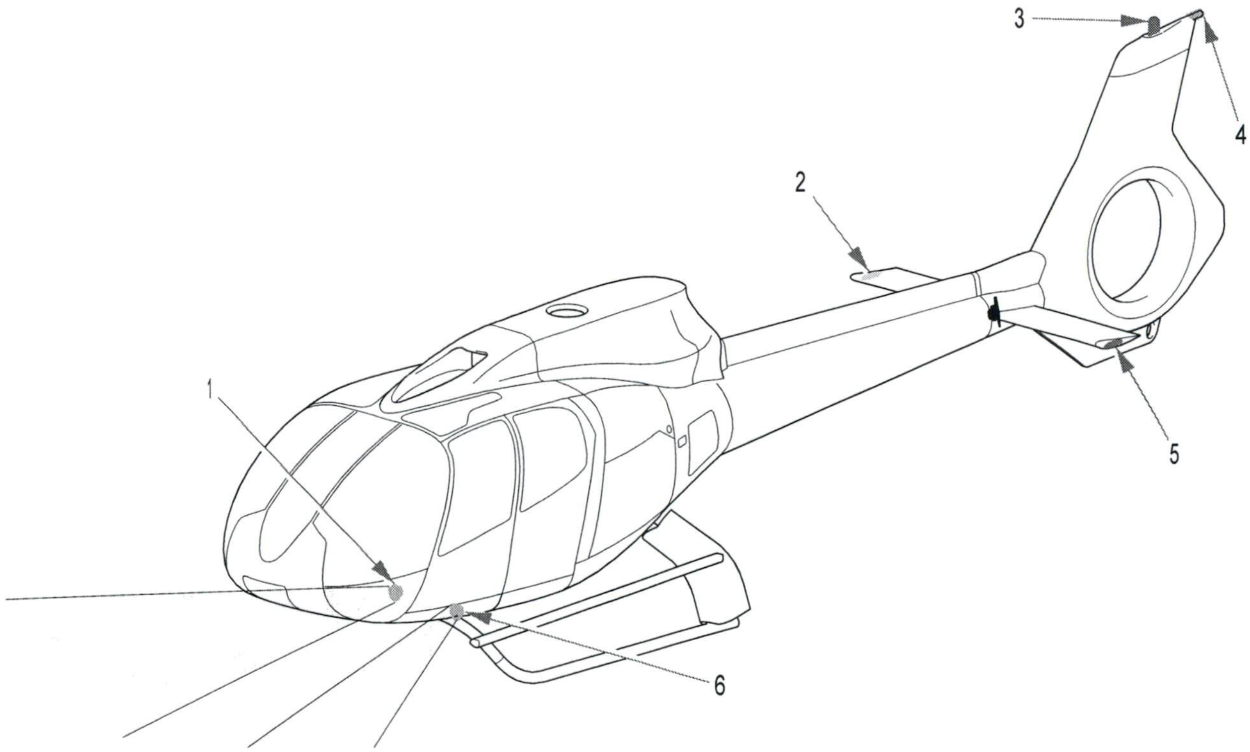
- the red position light (5)on the left end of the horizontal stabilizer,
- the green position light (2)on the right end of the horizontal stabilizer,
- the white position light (4)on the top of the fin,
- the anticollision light (3)on the fin fairing,
- the right fixed landing light (1)under the right bottom fairing,
- the left fixed taxi light (6)under the left bottom fairing (Pre MOD 07 3798) or under the central forward fairing (Post MOD 07 3798).

NOTE

The taxi light can be replaced by an optional adjustable / retractable light.

Post-MOD 073335 and MOD 073336, the position lights and the anti-collision light are fitted with an LED lighting. Maintenance is no longer required for these new lights.

Figure 1. External Lighting - General Description



For A/C : All

General Description

A. Description

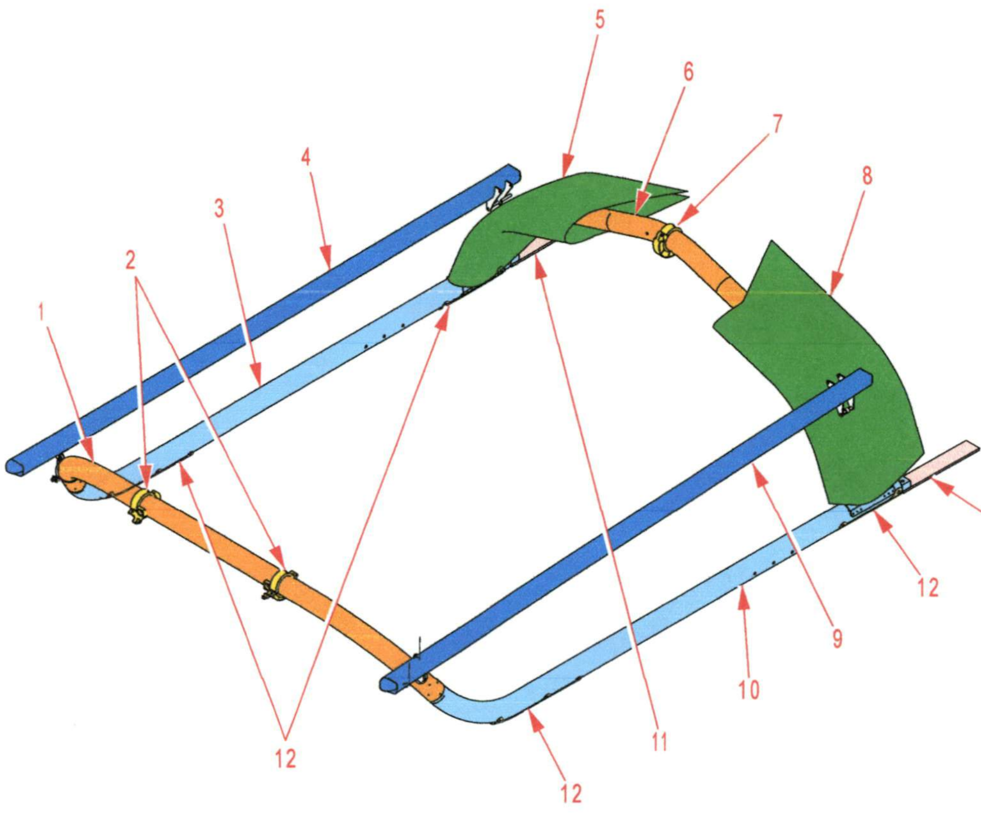
The components of the landing gear are:

- the forward cross-tube (1),
- the forward attachments (2),
- the skids (3)and (10),
- the aft cross-tube (6),
- the aft attachment (7),
- the footsteps (4)and (9),
- the fairings (5)and (8),
- the flexible strips (11),
- the wear plates (12).

B. Characteristics

Track	2310 mm (90.95 in.)
Length	2720 mm (107.09 in.)
Weight	40 kg (88.12 lb.)
Material	Aluminium

Figure 1. Main Landing Gear - General Description



For A/C : All

Detailed Description

A. Operation

The landing gear is attached under the bottom structure at three points:

- the forward cross-tube (1)is held by the half-bearings (6)and (8), the collars (9), and the fittings (7)(detail A).
- the aft cross-tube (2)is held by the half-bearings (12)and (14), and the collar (13)(detail B).

The electrical bonding braids (10)and (11)which connect the forward cross-tube (1)and the aft cross-tube (2)to the airframe ensure the equipotential state between the airframe and the landing gear.

The footsteps (3), with anti-slip strips, give access to the cabin. They are used to carry out servicing and maintenance operations on the transmission deck.

The removable fairings (4)attached to the aft cross-tube (2), make the aesthetic aspect and the aerodynamic load analysis of the aircraft better.

The skids (5)are protected by the wear plates (16)(reinforced Post MOD OP 3785) attached with screws to their bottom part (detail C). They have provisions to install equipment such as: the handling twin-wheels, the mooring devices, the emergency flotation gear, the skis.

The flexible strips (15)or (17)(POST MOD 072899), installed at the ends of the skids (5), increase the operating flexibility of the landing gear.

Figure 1. Main Landing Gear - Detailed Description

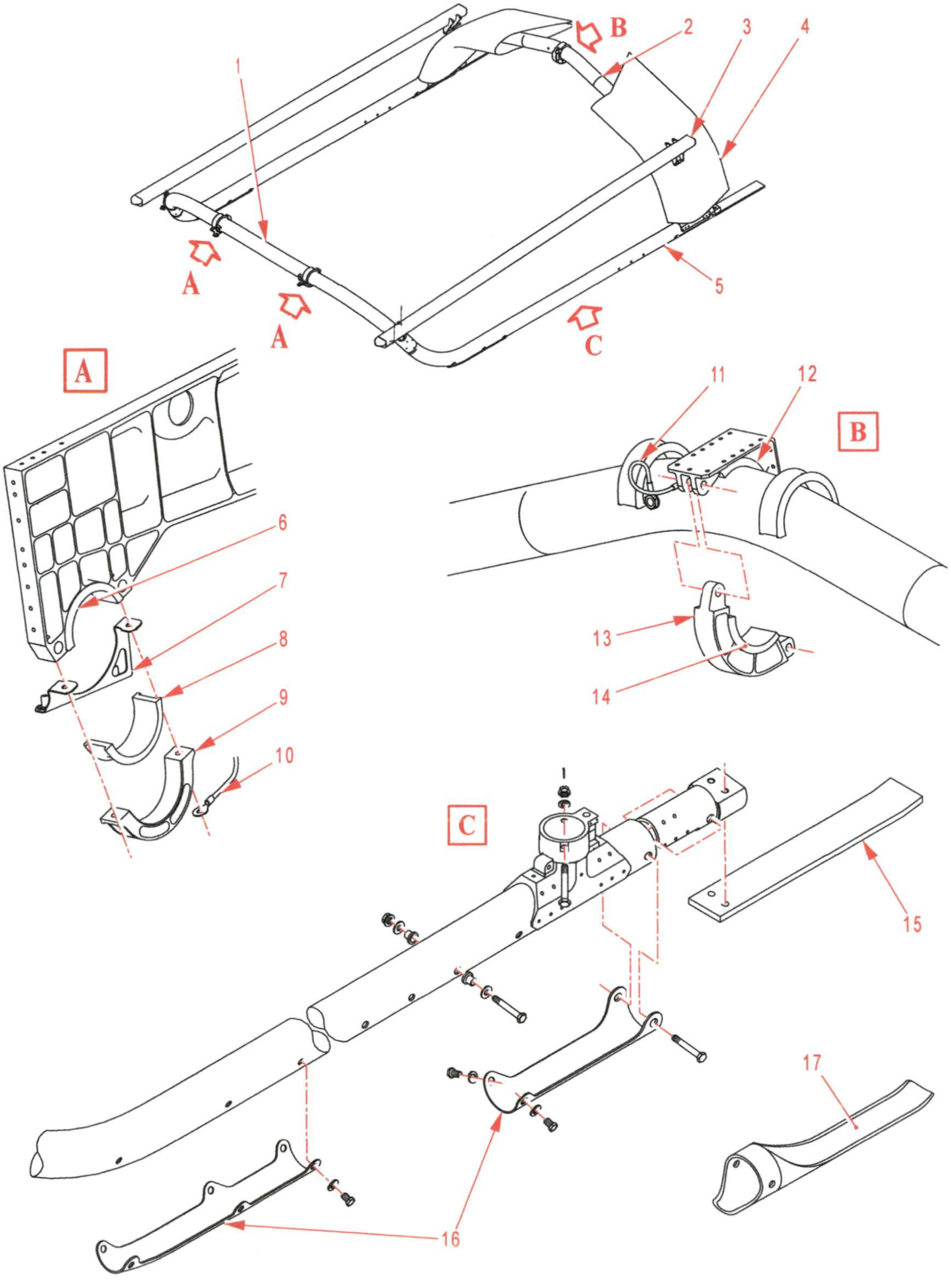
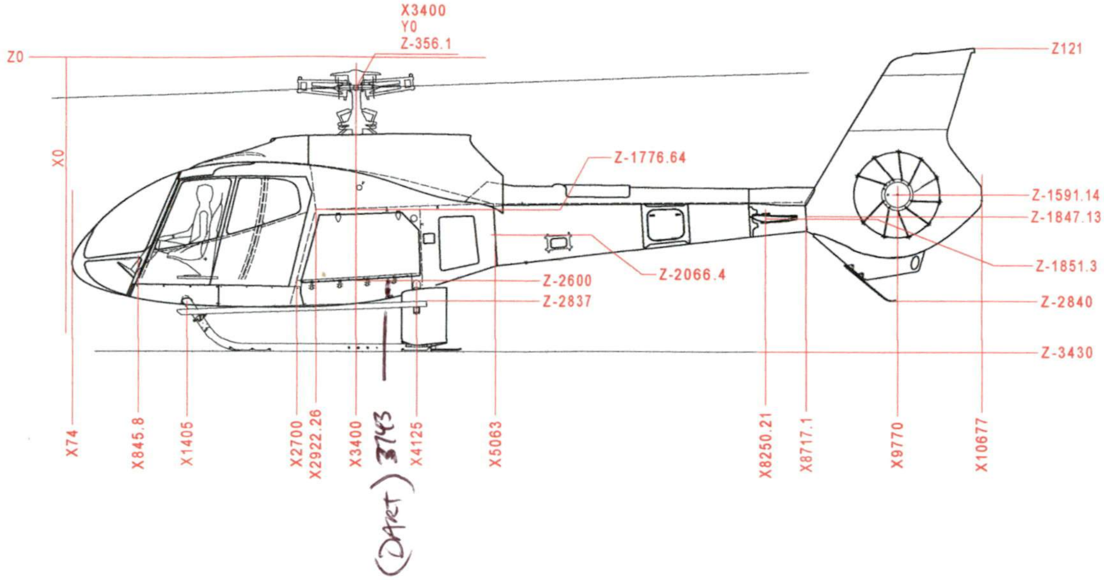
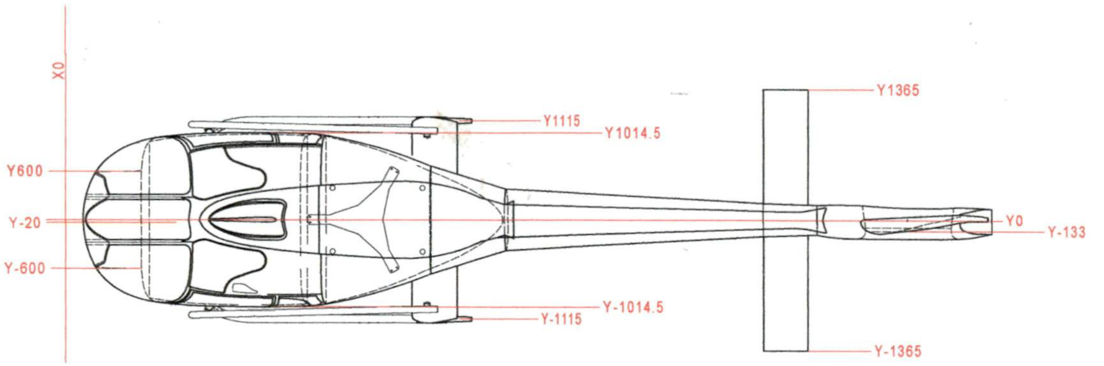


Figure 1. Location of the Main Components of the Structure - Helicopter





Jeff Clarke

From: Jim Tinson, Wings Engineering Ltd. [jim@wingsengineering.ca]

Sent: March 19, 2015 2:54 PM

To: 'Jeff Clarke'

Subject: WPN1507: New Project - EC130 Basket/Bike Rack/Steps

Hi Jeff,

You have worked hard on this concept.

Brainstorming Type Comments 1X3 x 1/8 =24 lb. + down tube

1. The lateral beams look a little light and twisty to me. (I really like square tubing and drag bracing.) not strong enough
2. Are you counting on the various racks to stabilize the beams?
   The Down Tubes with a Cargo Basket might work but the step and the Bike Rack have much shorter connector legs. Yes.
3. It looks like you could easily make a moment connection at the front using two barrel nuts per CT Strap (AD's Strap right?). Concern about loads on A/C connection
   or change the strap to accept thru bolts using standard nuts.
4. The aft connection could be changed to make the fitting to provide vertical strap bracket facing fwd with two bolt holes per bracket facing fwd and the aft beam would just bolt thru? bracket must stop under fairing
5. Are there any concerns about tripping (egress) over the Down Tubes for none Basket installs? Adjacent to pilot seat to be evaluated
6. Why not make adapter Down Tubes for the AS350/355 Cargo Baskets and connect to the beams via QR Pins? want to keep existing sytem, alignment of pins typ. a prob.
   Double shear design where the beam is the center lug between a clevis type mount.
   Use bushings thru the beams for long term wear.
7. Have you found any other uses for these new mounts? haven't looked, but expect so
   Because they look very handy.

I'm happy enough to sign off the CPR-DR with the understanding that this is early in the project and that we (AD-Wings) need to flush out the CP means and methods based on previous Cargo Basket programs prior TC's acceptance of the CP means and methods.

BTW is the application is to add the EC130 to the current AS350/355 Cargo Basket approval and to add an EC130 only Bike Rack & Step where a AS350/355 Bike Rack install is planned for a later revision to the approval???

hopefully together, Schedule may not work.

Cheers,

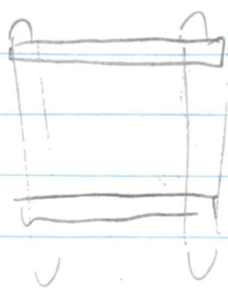
Jim Tinson FEC, PEng, DAR
T/F: 604.274.5647, C: 604.418.8955
WINGSENGINEERING.CA

From: Jeff Clarke [mailto:jeff@aerodesign.ca]
Sent: March-19-15 2:04 PM
To: 'Jim Tinson, Wings Engineering Ltd.'
Subject: New Project - EC130 Basket/Bike Rack/Steps

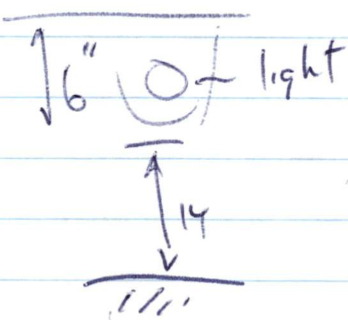
Hi Jim,

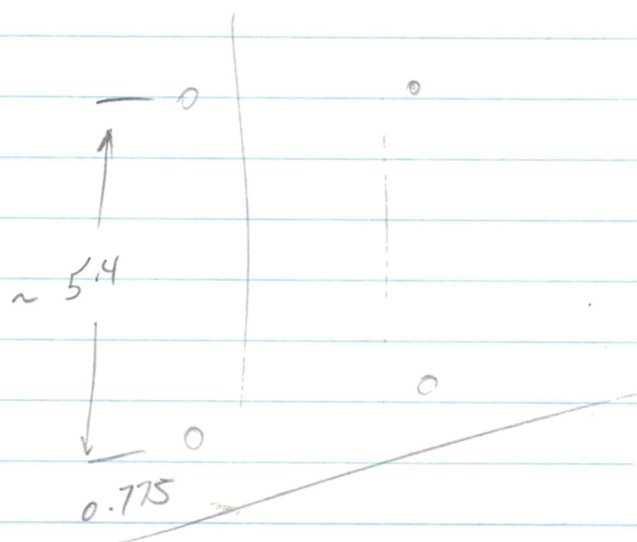
I have a new project – basket, bike racks and cabin steps for the EC130. We have access to an aircraft in Campbell River that we have taken measurements from a couple of times now. The plan is to make a prototype set of mounts to do a test fit in the next week or so. I am in contact with Airbus to see what I can get for loads at

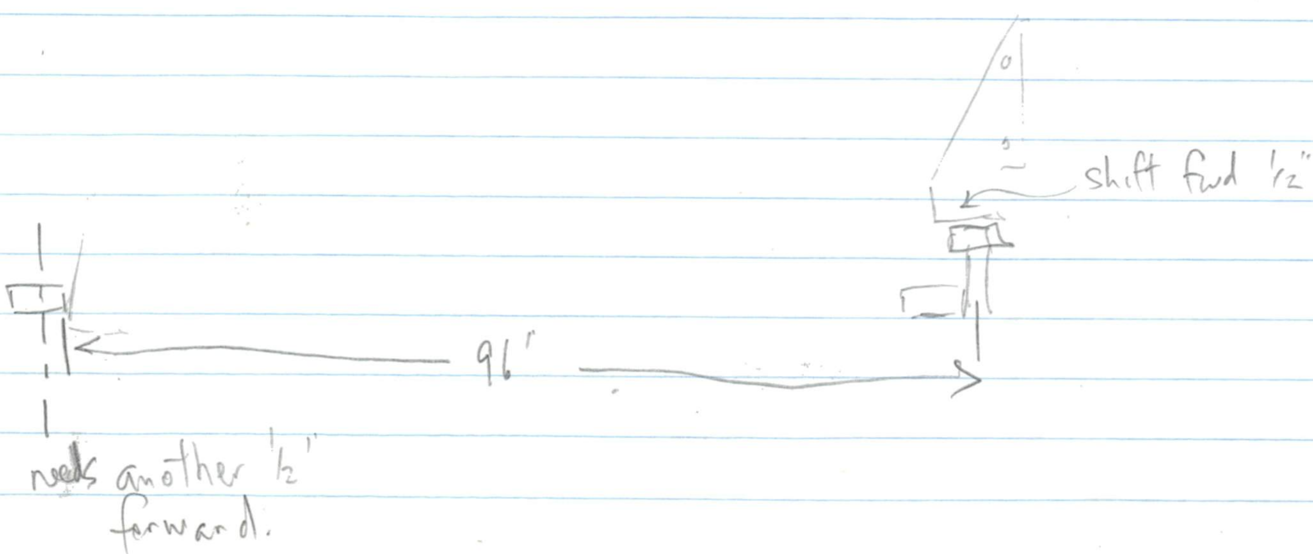
Front - beam hole spacing good
8' may be too wide   5 1/4" wider than step

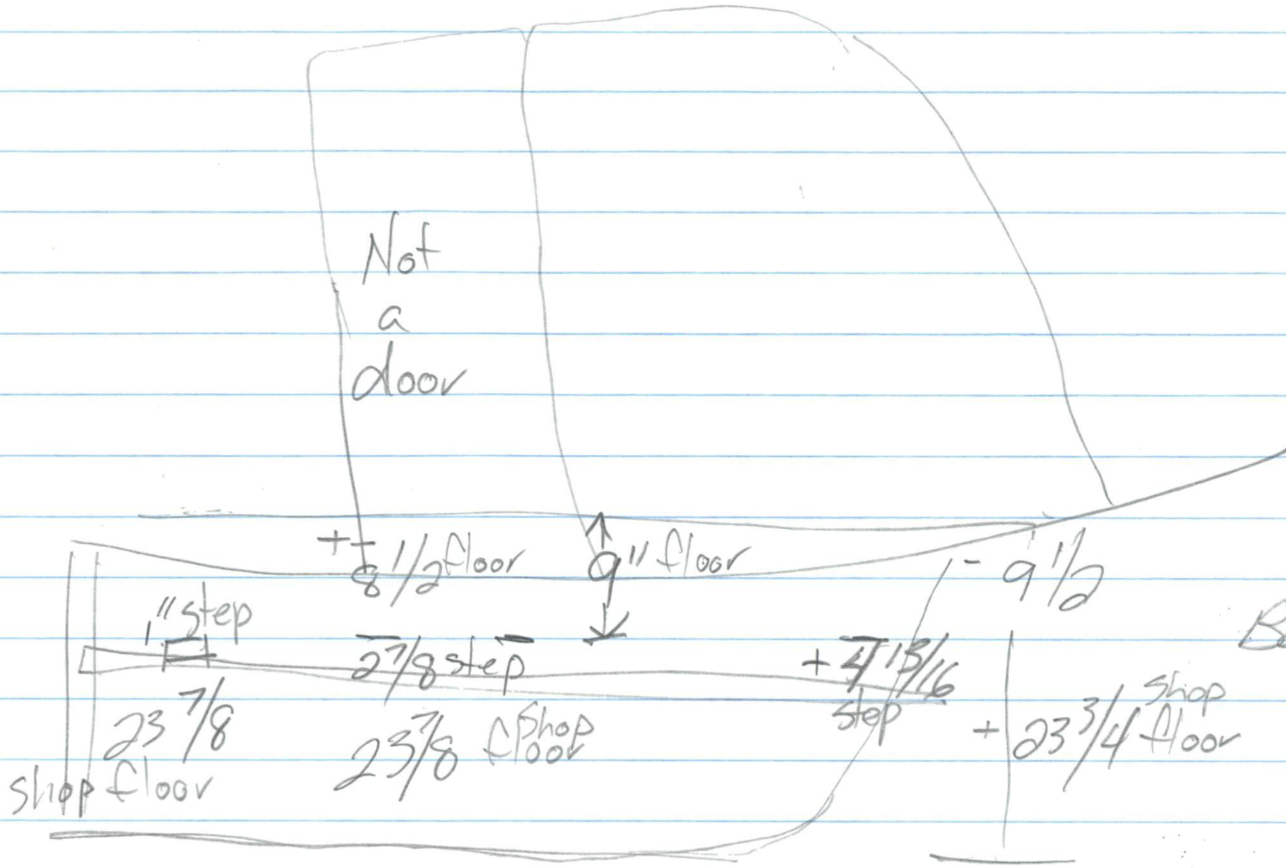


Step width outsides @ our tubes



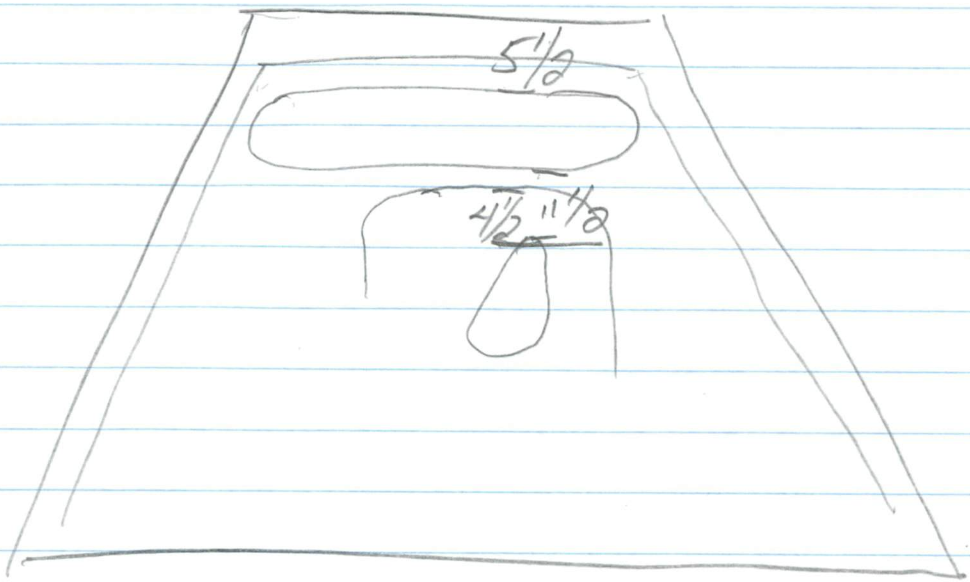






Not a door
8 1/2 floor
9" floor
9 1/2
1" step
2 7/8 step
4 13/16 step
Base
23 7/8
shop floor
23 7/8 shop floor
23 3/4 shop floor

Aft



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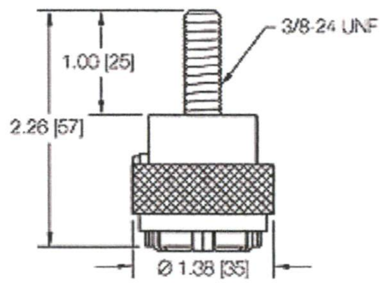
12 Jaw Fittings With 1" Threaded Stud 33115

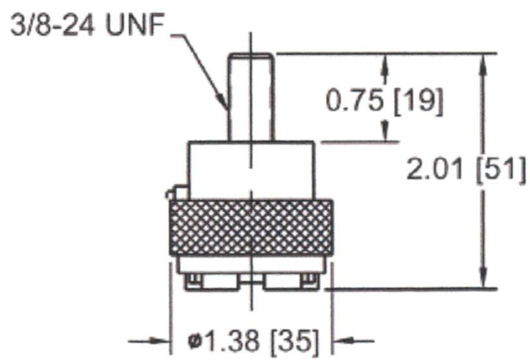


0° Vertical Breaking Strength: 5,475 lbs./2485 kgs.

90° Pull Angle Breaking Strength: 2,300 lbs./1045 kgs.

Weight: 0.22 lbs., 0.10 kgs.

12 Jaw Fittings With 3/4" Threaded Stud 33116



0° Vertical Breaking Strength: 5,475 lbs./2485 kgs.

Table 3.7.8.0(d). Design Mechanical and Physical Properties of 7175 Aluminum Alloy Extrusion

Specification	AMS 4344	
Form	Extrusion	
Condition	T73511	
Cross-Sectional Area, in^2	32-65	
Thickness or Diameter,[a] in.	0.250-0.999	1.000-2.000
Basis	S	S
Mechanical Properties:		
F_{tu}, ksi:		
L	69	69
LT	63	63
F_{ty}, ksi:		
L	59	59
LT	52	52
F_{cy}, ksi:		
L	...	59
LT	...	59
F_{su}, ksi	...	40
F_{bru}[b], ksi:		
(e/D = 1.5)	...	97
(e/D = 2.0)	...	125
F_{bry}[b], ksi:		
(e/D = 1.5)	...	79
(e/D = 2.0)	...	95
e, percent:		
L	...	8
LT	...	4
E, 10^3 ksi	10.1	
E_c, 10^3 ksi	10.5	
G, 10^3 ksi	3.9	
μ	0.33	
Physical Properties:		
ω, lb/in.^{3}	0.101	
C, Btu/(lb)(°F)	0.23 (at 212°F)	
K, Btu/[(hr)(ft^2)(°F)/ft]	...	
α, 10^{-6} in./in./°F	12.9 (68 to 212°F)	

a The mechanical properties are to be based upon the thickness at the time of quench.
b Bearing values are "dry pin" values per Section 1.4.7.1.

Table 3.7.6.0(g_1). Design Mechanical and Physical Properties of 7075 Aluminum Alloy Extrusion

Specification	AMS-QQ-A-200/11														
Form	Extrusion (rod, bar, and shapes)														
Temper	T6, T6510, T6511, and T62[a]														
Cross-Sectional Area, in.^{2}	≤20												>20, ≤32	≤32	
Thickness, in.[b]	≤0.249		0.250-0.499		0.500-0.749		0.750-1.499		1.500-2.999		3.000-4.499			4.500-5.000	
Basis	A	B	A	B	A	B	A	B	A	B	A	B	S	A	B
Mechanical Properties:															
F_{tu}, ksi:															
L	78	82	81	85	81	85	81	85	81	85	81	84	78	78	81
LT	75	79	78	82	77	81	75	79	71	75	67	69	64	63	65
ST	...	...	...	...	...	...	...	...	67[c]	71[c]	67[c]	69[c]	64[c]	63[c]	65[c]
F_{ty}, ksi:															
L	70	74	73	77	72	76	72	76	72	76	71	74	70	68	71
LT	66	70	69	72	67	71	65	69	61	65	56	59	55	52	55
ST	...	...	...	...	...	...	...	...	56[c]	59[c]	55[c]	58[c]	55[c]	52[c]	55[c]
F_{cy}, ksi:															
L	70	74	73	77	72	76	72	76	72	76	71	74	70	68	71
LT	72	76	74	78	73	77	71	75	67	71	62	64	61	57	60
ST	...	...	...	...	...	...	...	...	62	66	62	64	61	57	60
F_{su}, ksi	41	44	43	45	43	45	43	45	42	44	40	42	39	38	40
F_{bru}[d], ksi:															
(e/D = 1.5)	111	117	115	121	115	120	113	119	110	115	106	110	102	101	105
(e/D = 2.0)	140	148	146	153	145	152	144	151	141	148	137	142	132	131	136
F_{bry}[d], ksi:															
(e/D = 1.5)	92	97	96	101	94	99	93	98	89	94	84	88	83	79	83
(e/D = 2.0)	108	114	113	119	111	117	110	116	106	112	101	105	100	95	100
e, percent (S-basis):															
L	7	...	7	...	7	...	7	...	7	...	7	...	6	6	...
E, 10^3 ksi	10.4														
E_c, 10^3 ksi	10.7														
G, 10^3 ksi	4.0														
μ	0.33														
Physical Properties:															
ω, lb/in.^{3}	0.101														
C, K, and α	See Figure 3.7.6.0														

a Design allowables were based upon data obtained from testing T6, T6510, and T6511 temper extrusions and from testing samples of extrusion supplied in the O or F temper, which were heat treated to T62 temper to demonstrate response to heat treatment by suppliers. Properties obtained by the user may be lower than those listed if the material has been formed or otherwise cold worked, particularly in the annealed temper, prior to solution heat treatment.

b The mechanical properties are to be based upon the thickness at the time of quench.

c Caution: This specific alloy, temper, and product form exhibits poor stress-corrosion cracking resistance in this grain direction. It corresponds to an SCC resistance rating of D, as indicated in Table 3.1.2.3.1(a).

d Bearing values are "dry pin" values per Section 1.4.7.1.

Table 3.7.6.0(g_2). Design Mechanical and Physical Properties of 7075 Aluminum Alloy Extrusion—Continued

Specification	AMS-QQ-A-200/11													
Form	Extrusion (rod, bars, and shapes)													
Temper	T73[a], T73510, T73511													
Cross-Sectional Area, in.^{2}	≤20		≤25								≤20		>20, ≤32	
Thickness, in.[b]	0.062-0.249		0.250-0.499		0.500-0.749		0.750-1.499		1.500-2.999		3.000-4.499		3.000-4.499	
Basis	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Mechanical Properties:														
F_{tu}, ksi:														
L	68[c]	72	70[d]	74	70[d]	73	70[d]	73	69[d]	74	68[c]	71	65[e]	70
LT	66	70	68	72	67	70	66	69	62	67	58	61	56	60
F_{ty}, ksi:														
L	58	61	60	63	60	63	60	63	59[d]	65	57[c]	62	55[e]	60
LT	56	59	57	60	57	60	56	58	51	56	46	50	44	48
F_{cy}, ksi:														
L	58	61	60	63	60	63	60	63	59	65	57	62	55	60
LT	59	62	60	63	60	63	58	61	54	59	49	53	47	51
F_{su}, ksi	37	39	38	40	38	39	38	39	37	40	37	38	35	38
F_{bru}[f], ksi:														
(e/D = 1.5)	101	107	104	110	103	108	103	107	99	106	95	99	91	98
(e/D = 2.0)	129	137	133	141	133	139	132	138	128	138	124	130	119	128
F_{bry}[f], ksi:														
(e/D = 1.5)	82	86	84	89	84	88	83	87	79	87	72	79	70	76
(e/D = 2.0)	97	102	100	105	100	105	98	103	93	103	86	94	83	91
e, percent (S-basis):														
L	7	...	8	...	8	...	8	...	8	...	7	...	7	...
E, 10^3 ksi	10.4													
E_c, 10^3 ksi	10.7													
G, 10^3 ksi	4.0													
μ	0.33													
Physical Properties:														
ω, lb/in.^{3}	0.101													
C, K, and α	See Figure 3.7.6.0													

a Design allowables were based upon data obtained from testing T7351X temper extrusions and from testing samples of extrusions supplied in the O or F temper, which were heat treated to T73 temper to demonstrate response to treatment by suppliers. Properties obtained by the user may be lower than those listed if the material has been formed or otherwise cold worked, particularly in the annealed temper.

b The mechanical properties are to be based upon the thickness at the time of quench.

c S-basis. Rounded T_{99} values for cross sectional area ≤20 are as follows: for 0.062-0.249 F_{tu}(L) = 69 ksi, 3.000-4.499 F_{tu}(L) = 69 ksi, F_{ty}(L) = 59 ksi.

d S-basis. Rounded T_{99} values for cross sectional area ≤25 are as follows: 0.250-1.499 F_{tu}(L)= 71, 1.500-2.999 F_{tu}(L)= 72 ksi and F_{ty}(L) = 62 ksi.

e S-basis. Rounded T_{99} values for cross sectional area >20 and ≤32 are as follows: F_{tu}(L) = 68 ksi and F_{ty}(L) = 57 ksi.

f Bearing values are "dry pin" values per Section 1.4.7.1.

Table 3.7.6.0(g$_3$). Design Mechanical and Physical Properties of 7075 Aluminum Alloy Extrusion—Continued

Specification	AMS-QQ-A-200/15						
Form	Extrusion (rod, bar, and shapes)						
Temper	T76, T76510, T76511						
Cross-Sectional Area, in.^{2}	≤20						
Thickness, in.[a]	0.062-0.249		0.250-0.499	0.500-0.749		0.750-1.000	
Basis	A	B	S	A	B	A	B
Mechanical Properties:							
F_{tu}, ksi:							
L	71	74	75	75	76	75	76
LT	68	71	72	71	73	70	71
F_{ty}, ksi:							
L	61	65	65	65	67	65	67
LT	57	61	61	60	62	59	61
F_{cy}, ksi:							
L	61	65	65	65	67	65	67
LT	62	66	66	65	67	64	66
F_{su}, ksi	38	40	41	41	42	40	41
F_{bru}[b], ksi:							
(e/D = 1.5)	103	107	109	109	110	109	110
(e/D = 2.0)	131	137	139	139	141	139	141
F_{bry}[b], ksi:							
(e/D = 1.5)	82	88	88	88	90	88	90
(e/D = 2.0)	98	104	104	104	107	104	107
e, percent (S-basis):							
L	7	...	7	7	...	7	...
E, 10^3 ksi	10.4						
E_c, 10^3 ksi	10.7						
G, 10^3 ksi	4.0						
μ	0.33						
Physical Properties:							
ω, lb/in.^{3}	0.101						
C, K, and α	See Figure 3.7.6.0						

a The mechanical properties are to be based upon the thickness at the time of quench.
b Bearing values are "dry pin" values per Section 1.4.7.1.

REVISED TO REMOVE BIKE RACK

Transport Canada | Transports Canada

DESIGN CHANGE APPROVAL APPLICATION

DEMANDE D'APPROBATION D'UNE MODIFICATION DE LA CONCEPTION

Legal name and address of applicant / Nom et adresse légal du demandeur	Legal name and address of prospective holder / Nom et adresse légal du titulaire éventuel	Name and address for billing purposes (if different than applicant) / Nom et adresse aux fins de facturation (si différent du demandeur)
Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	Aero Design Ltd. 9888A Malaspina Road Powell River, BC, Canada V8A 0G3	

Identification of aeronautical product / Identification du produit aéronautique

Make / Marque	Model / Modèle	Registration / Immatriculation	Serial No. / N° du série	Part No. / N° de la pièce
Airbus Helicopters	EC130	All eligible	All eligible	

Request for (check appropriate box) / Objet de la demande (Cochez les carrés selon le cas)

- [ ] STC / CTS
- [ ] STC (single serial number) / CTS (numéro de série simple)
- [ ] STC (multiple serial numbers) / CTS (numéros de série multiples)
- [ ] Type Certificate Revision / Revision de certificat de type
- [x] Revision / Révision — No. / N° SH08-16 — Current Issue / Édition active 5
- [ ] Repair Design Approval (RDA) / Approbation de la conception de réparation (ACR)
- [ ] Repair Design Approval - Process Repair / ACR - Processus de réparation
- [ ] Part Design Approval (PDA) / Approbation de la conception de pièce (ACP)

Type Design Examination by Foreign Authority / Examen de la définition de type par autorité étrangère

- [ ] Application to a foreign authority is requested / La demande à une autorité étrangère est demandée.
- [ ] Type design examination of foreign change / Examen de la définition de type modification étrangère

Identify / Identifier

- [ ] Restricted Category / Catégorie restreinte — Type of Operation / Type d'opération

Title and brief description of modification, repair or replacement part, including effects of changes (use additional pages if necessary). Refer to CAR 521.155(b)(i) for details.
Titre et brève description de la modification, de la réparation ou de la pièce de rechange, y compris les effets des changements (utiliser des feuilles supplémentaires si nécessaire). Référez-vous à RAC 521.155(b)(i) pour des détails.

External Cargo Basket, Bicycle Rack and Cabin Steps Installation - Installation of mounting provisions on the fuselage; installation of quick release cargo basket, bike rack or cabin step on mounting provisions

Applicable Type Certificate (TC) / Certificat de type (CT) pertinent

TC No. / N° de CT	Issue No. / N° de l'édition	Identify State of Design / Identifier l'état de conception
H-83	22	EASA

The applicant is responsible for the control of product manufacture / Le demandeur est responsable du contôle de la fabrication du produit

- [x] Yes / Oui
- [ ] No / Non

If no, identify who is responsible / Si non, identifier qui est responsable

Documentation to be submitted / Documentation à soumettre	Applicant / Demandeur — Submitted / Soumis: Yes / Oui	No / Non
Proposed certification basis / Proposition de base de certification	✓	
Certification plan in accordance with CAR 521.155(d) / Plan de certification selon RAC 521.155(d)	✓	

Applicant's remarks / Remarques du demandeur

Revision is to add EC130 configuration

I hereby certify that the information contained herein is correct and complete. I agree to pay charges as prescribed in Part 1, Subpart 4 of the CARs (CAR 104-Charges).

Je certifie que les renseignements figurant ci-dessus sont exacts et complets. Je m'engage à payer les redevances prescrites à la sous-partie 4 de la partie I du RAC (sous-partie 104 du RAC - Redevances).

JEFF CLARKE	VICE PRESIDENT	2015-04-27
Name and Signature of Applicant / Nom et signature du demandeur	Title / Poste	Date (yyyy-mm-dd) / Date (aaaa-mm-jj)

26-0469 (1007-06)

Canada

CERTIFICATION PLAN

CP1009

AIRBUS HELICOPTERS EC130

EXTERNAL MOUNTING PROVISIONS INSTALLATION
QUICK RELEASE CARGO BASKET INSTALLATION
QUICK RELEASE BICYCLE RACK INSTALLATION
QUICK RELEASE CABIN STEP INSTALLATION

NOT CURRENT

Prepared by: Jeff Clarke, P.Tech.(Eng.)

Revision 0, 19 March 2015

Aero Design Ltd.

9888A Malaspina Road, Powell River, BC, V8A 0G3
Phone: 604-483-2376
Fax: 604-483-2372
www.aerodesign.ca

TABLE OF CONTENTS

1.0 INTRODUCTION

This certification plan details the means and methods of compliance for the Airworthiness Requirements shown on the Compliance Program Checklist (Appendix A).

This reissue of STC SH08-16 adds the Airbus Helicopters EC130 configurations to the existing Airbus Helicopters AS350/AS355 configurations as both models share the same type certificate data sheet and the installations use many of the same components.

2.0 DEFINITIONS

The following abbreviations are used in this document:

FMS – Flight Manual Supplement

ICA – Instructions for Continued Airworthiness

3.0 PERSONNEL

Applicant: Aero Design Ltd. – Jeff Clarke, P.Tech.(Eng.)

Delegate: DAR304 James Tinson, P.Eng.

Transport Canada: Jack Staal, PNR Region

4.0 PROJECT DESCRIPTION

4.1 General

Aero Design Ltd. produces cargo baskets and cabin steps for many helicopter models. All Aero Design baskets use similar mounting provisions which incorporate the same quick release system. This new configuration for the Airbus Helicopters EC130 draws elements from a number of other models: the fuselage attachments are similar to the Bell 206B configuration; the mounting beams are similar to those used on the Bell 206L/407; the basket is identical to the AS350 extra large basket using the mounting points at the end of the basket from the AS350 short basket configuration; the cabin step is similar to the maintenance steps for the AS350; the bicycle rack is identical to the rack in development for the AS350.

4.2 Fixed Mounting Provisions

The fixed mounting provisions consist of the fuselage attachment points and the mounting beams which incorporate the quick release mechanism.

The forward fuselage attachment replaces the original forward crosstube clamps (item 9 in figure 4.2.1) with a new fitting incorporating a hardpoint (figure 4.2.2). The original clamp is a machined aluminum fitting. The replacement clamp is also a machined aluminum fitting, made of 7075 aluminum to provide for maximum strength due to the unspecified original material. It is dimensionally similar to the original part at the mounting holes and in the inside radius where the cross tube seats with the original rubber pad. The hardpoint is a lateral hole housing a barrel nut for attaching the mounting beam, identical to the Aero Design Bell 206L/407 attachment provisions (49301-01 and 60602-01). The forward mounting beam is then bolted to the fittings.

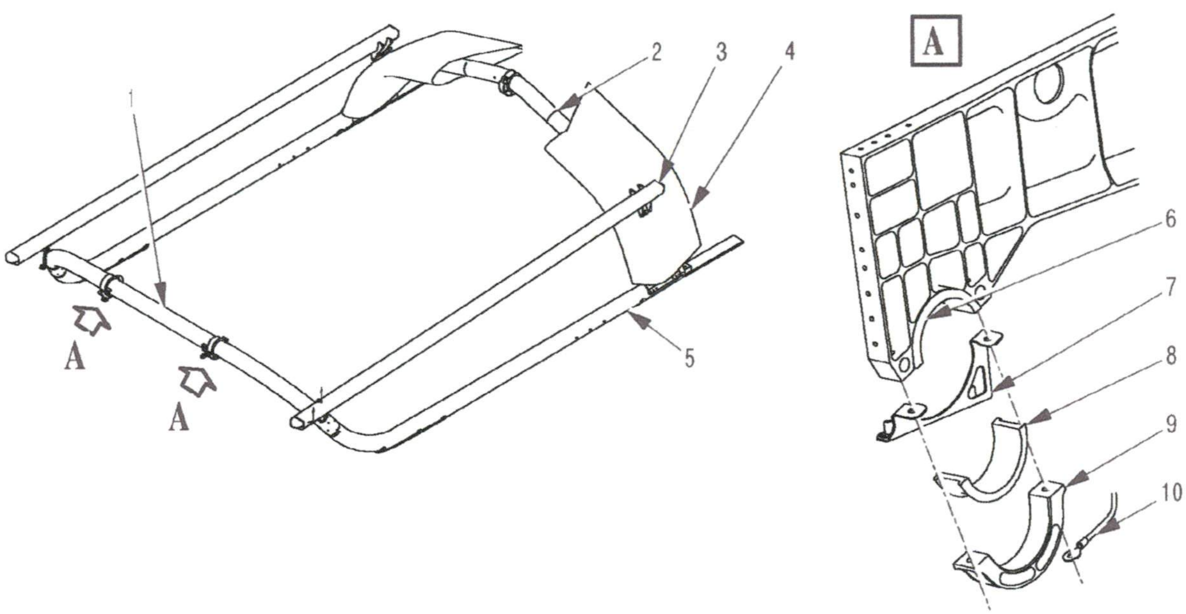


Figure 4.2.1 – Original Landing Gear Attachments

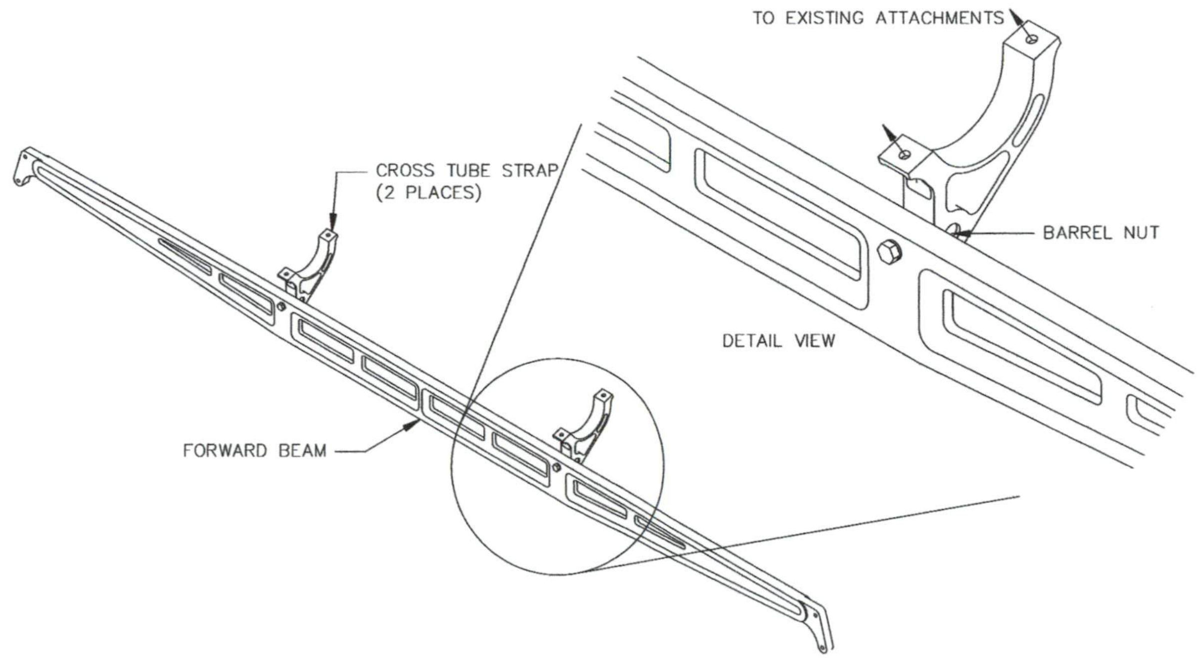


Figure 4.2.2 – Forward Attachment Provisions

The aft attachment picks up on the main fuselage frames at the aft fuel cell cross member (figure 4.2.3, "A"). The aft fuel cell cross member includes the aft attachment points for the cargo swing (2557 lbs slung load), which can be used to calculate the allowable loads on the frame. In order to install the lower aft fuselage fairing panel, which slides between the fuselage frames and landing gear fairings with little room to rotate, the aft attachment fittings cannot extend lower than the fairing panel once installed. To simplify installation and reduce the required cutout size in the fairing panel, the fitting incorporates a seat track type stud fitting, the same as the basket attachments. The mounting beam attaches to the fitting with a seat type claw fitting (see figure 4.2.4), the same as used with the Aero Design Rappel and Cargo Deployment System. The claw fitting is secured with a locking ring, also used with the Rappel and Cargo Deployment System, to prevent inadvertent release.

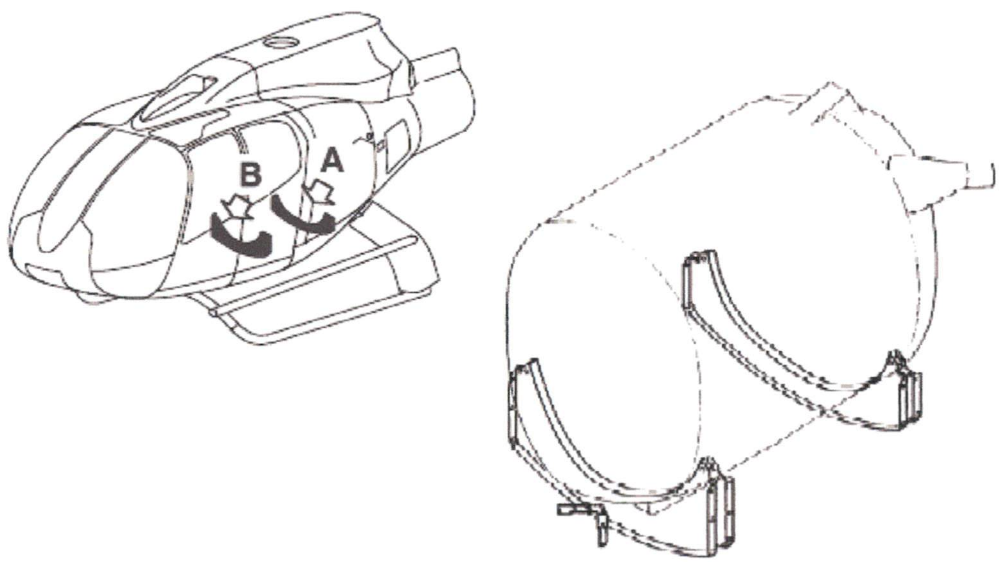


Figure 4.2.3 – Fuel Cell Support Members

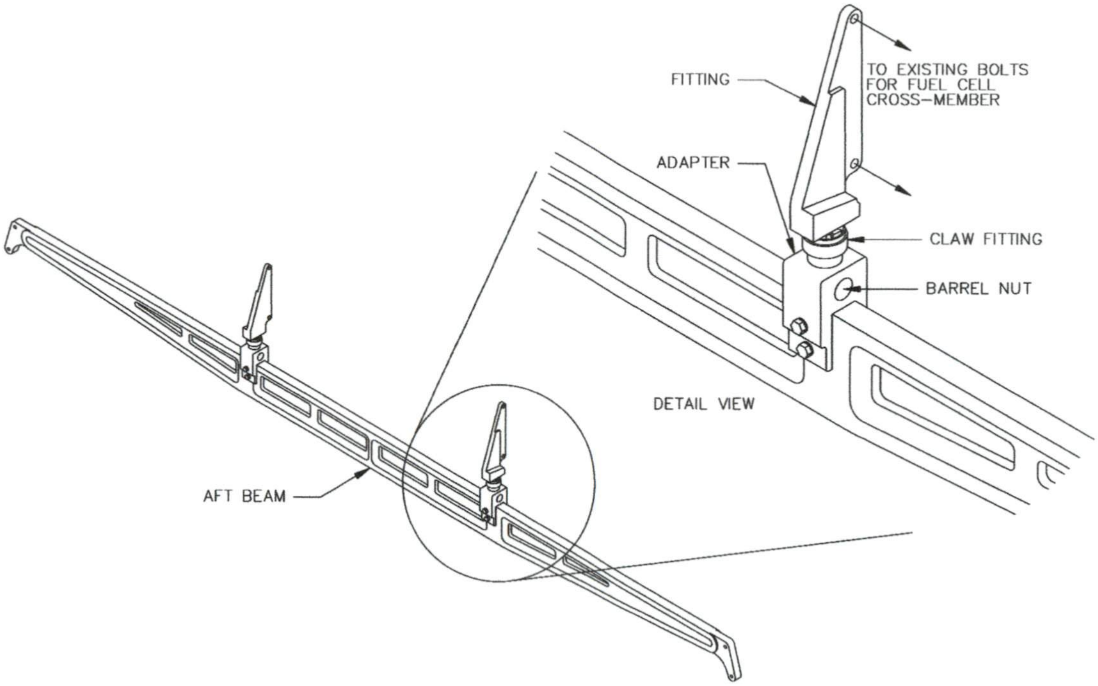


Figure 4.2.4 – Aft Attachment Provisions

The forward and aft mounting beams are machined 7075-T6 aluminum bars, spanning the width of the fuselage, approximately 96 inches (2.4 m) wide. The beams are pocketed with through holes to reduce weight and allow airflow through the beam.

Stainless steel down tubes, with keyways in the outboard faces for attaching the basket or other equipment, are attached to the outboard ends of the aluminum beams. The down tubes are virtually identical to all other Aero Design mounting beams. The arrangement of horizontal and vertical keyways allows the use of a single pin to retain the basket, step or bike rack, simplifying installation and removal.

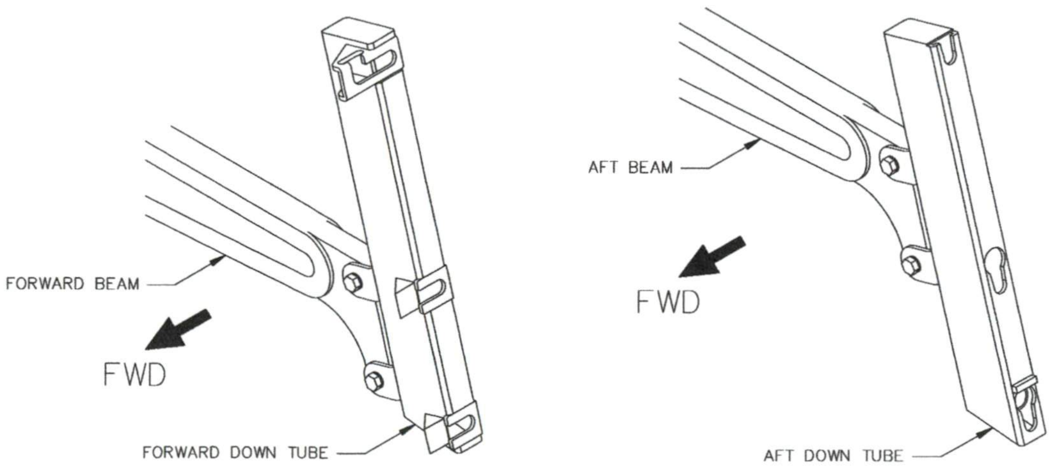


Figure 4.2.5 – Down Tubes

4.3 Quick Release Cargo Basket

The extra large Quick Release Cargo Basket developed by Aero Design Ltd. for the AS350 is the right size for operators using the EC130 for heli-ski, tourism, and utility contracts. The only difference between the existing AS350 extra large basket (model 940) and the EC130 basket is the attachment points are moved to the first and last hoops, which is the same configuration as the AS350 medium and short baskets (model 764 and 776). All other construction of the basket remains the same as basket model 940. The 300 lb (136 kg) cargo load limit also remains the same.

The basket and lid are fabricated from a welded 4130 steel tubing structure (3/4" rims, ½" hoops and spines), and lined with expanded steel mesh. The basket attachments are located on the most forward and aft hoops of the basket. The end hoops include a brace strut tube to support the outboard edge of the basket back to the attachment points. The lid is attached with extruded hinge, riveted to the structure. The lid is secured closed with the handle, which is locked into brackets on the basket body, with an additional safety catch included that will retain the lid in the event the handle is not correctly latched. The lid is held open with a sliding brace that automatically locks in the open position and must be manually unlatched to close the lid.

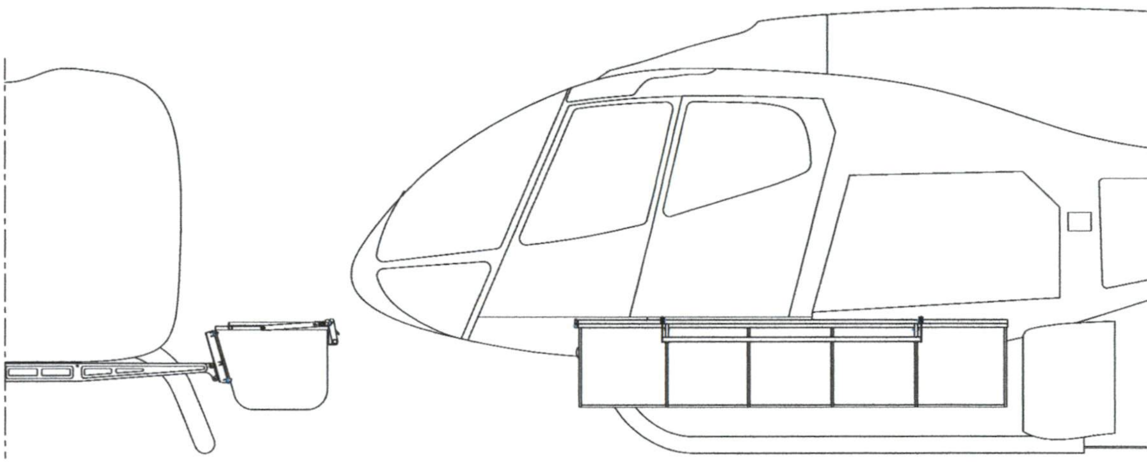


Figure 4.3.1 – Quick Release Cargo Basket

4.4 Quick Release Cabin Step

Installation of the Mounting Provisions will require removal of the existing cabin step. When the helicopter will be operated without the cargo basket or installed equipment a step to access the cabin will be required.

The Quick Release Cabin Step is installed on the helicopter using the Mounting Provisions supplied for use with the Quick Release Cargo Basket. The step is an aluminum extrusion, with aluminum brackets welded to the ends with fittings that engage in the mounting beams. The step locks into the same mechanism on the mounting beams as the basket.

The step is similar to the cabin step used for the Bell 429, however the length is increased from 74.75" to 96".

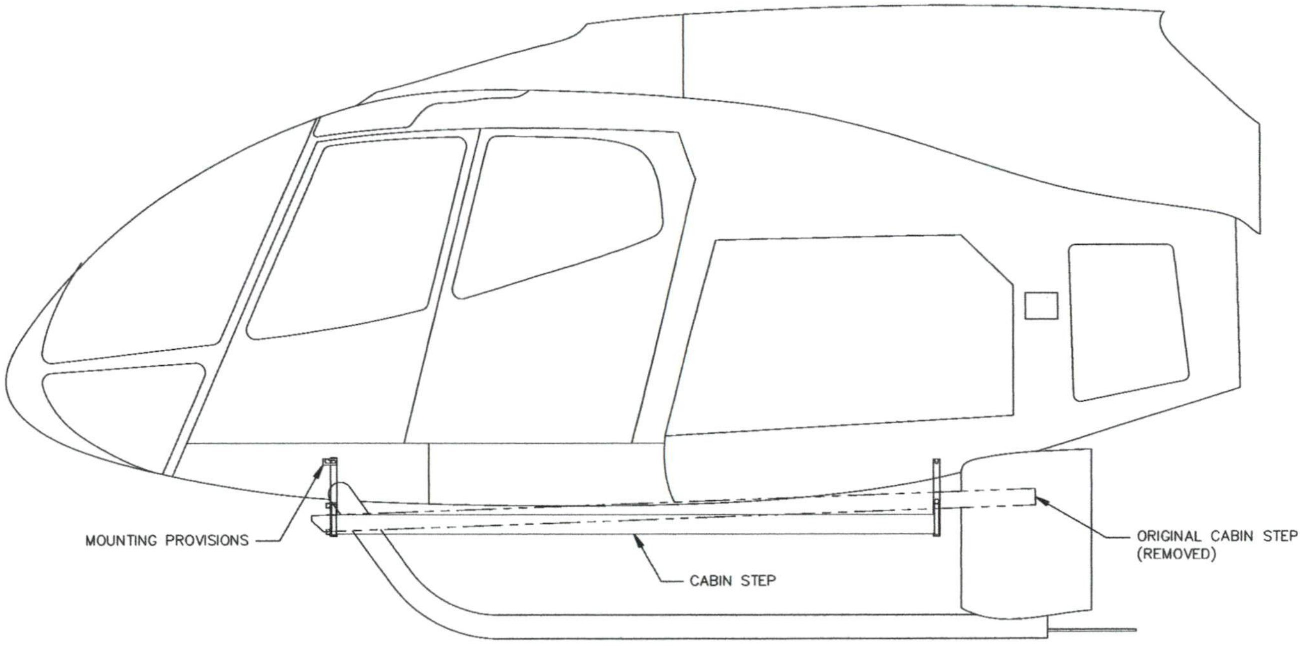


Figure 4.4.1 – Quick Release Cabin Step

4.5 Quick Release Bicycle Rack

The Quick Release Bicycle Rack is installed on the helicopter using the Mounting Provisions supplied for use with the Quick Release Cargo Basket. The rack can support up to 3 bikes and can be installed on both sides of the helicopter for a total of 6. The rack itself consists of 3 parallel tracks made of the aluminum extrusion used for cabin steps, with stainless steel tubing frames to secure the bicycles. The tube frames can accommodate tires from 26" – 29" (660 – 737 mm) diameter and up to 4" (100 mm) wide, standard sizes for mountain and downhill biking. The aft tube frame is fixed in position; the forward frame slides to allow for a tight fit on the range of tire and frame sizes. The forward frame locks to the track with a cam action that puts pressure aft and down to secure the bicycle tightly into the frame. The cam action will also secure the forward frame from moving when there is no bike on the rack.

The rack is located to place the bikes aft of the cabin doors. The most inboard rail extends forward to provide a step for accessing the cabin.

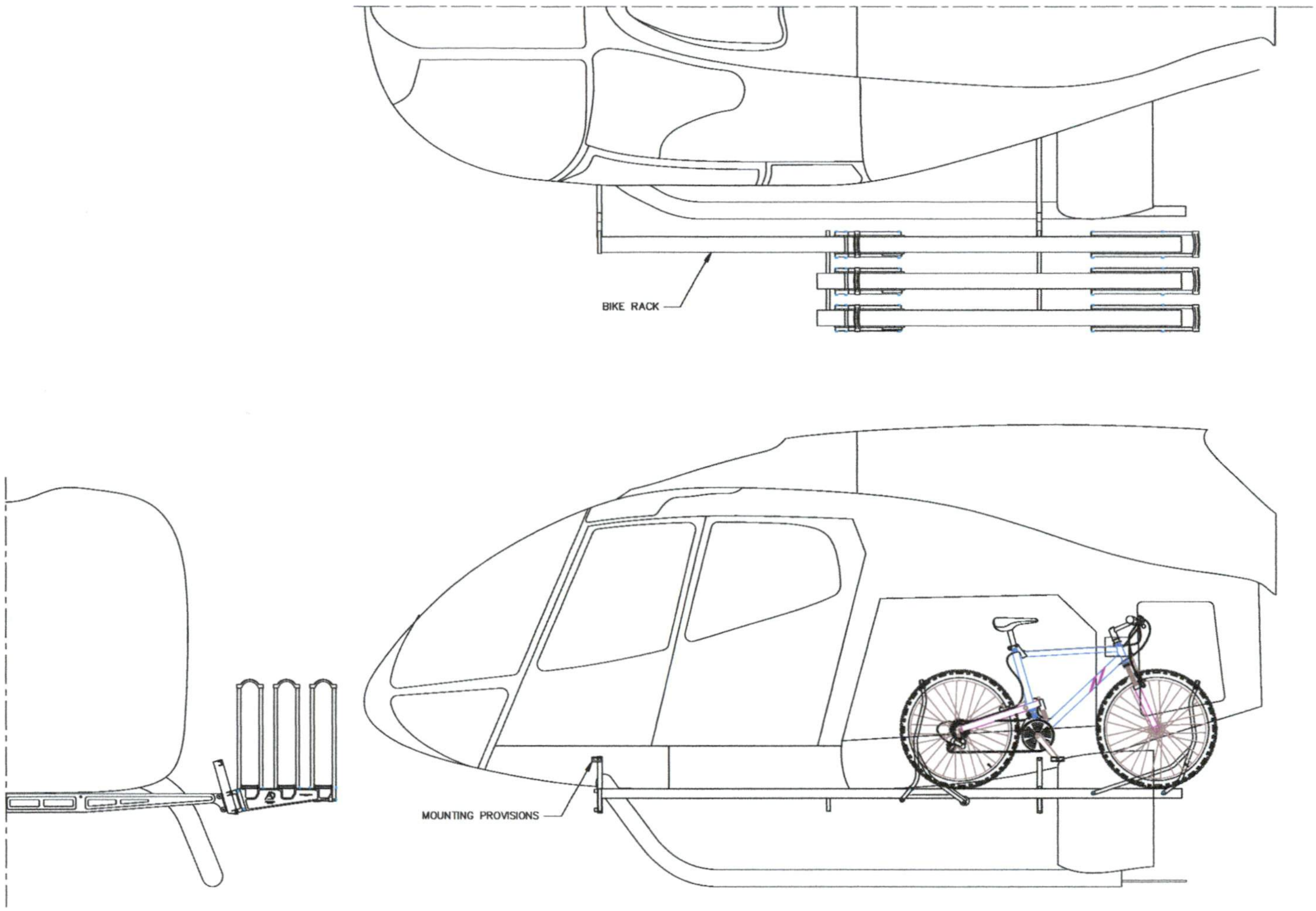


Figure 2.3 – Quick Release Bicycle Rack

4.6 Comparison of Configurations

The following information is preliminary in nature and subject to change.

Configuration	Max Load	Weight	Length (outside)	Width (outside)	Depth (outside)	Frontal Area	Long. C of G	Lateral C of G
Provisions	N/A	46 lbs	N/A	N/A	N/A	256 in^2	100.9 in	0.0 in
Basket	300 lbs	75 lbs	97.0 in	25.5 in	20.2 in	458 in^2	100.9 in	62.4 in
Cabin Step	N/A	6.6 lbs	96.75 in	4.7 in	4.8 in	11.6 in^2	100.9 in	52.5 in
Bike Rack (3 bikes max)	150 lbs	70 lbs	127.0 in	23.0 in	29.0 in	714 in^2	149 in	61.5 in

5.0 BASIS OF CERTIFICATION

Model: Airbus Helicopters EC130 B4, EC130 T2

TCDS:

- TCCA: H-83 Issue 22
- FAA: H9EU Revision 23
- EASA: R.008 Issue 8

5.1 TCCA Basis of Certification

5.1.1 TCCA – TCDS H-83, Issue 22

The certification basis is as follows (EC130 T2, most recent):

a) AWM 527 at Change 527-3 dated January 3,1994 plus the technical standards contained in:

i) FAR 27 Amdt 27-29; adopted by NPA 94-14
ii) FAR 27 Amdt 27-30; adopted by NPA 95-02
iii) FAR 27 Amdt 27-32; adopted by NPA 96-02

which is equivalent to:

i) JAR 27 first issue dated September 6; 1993 with orange paper Amdt 27/98/1 effective February 16, 1998; plus

ii) the following Airworthiness Requirements as published in the AWM Chapter 527, Change 527-3 dated January 3,1994:

527.1093 (b)(I) Engine Operation in Snow
527.1301-1 Rotorcraft Operations After Ground Cold Soak
527.1557(c)(3) Miscellaneous Markings and Placards
527.1581(e), (f) Rotorcraft Flight Manual

b) AWM 527.1317 at Change 7 published December 30, 2012.

c) Special Conditions:
i) Rotor Drive System Endurance Test for HIP rating (EASA CRI E-02).

d) Equivalent Safety Findings on:
i) Main Gearbox Oil Filter By Pass (EASA CRI A-01); and
ii) Powerplant Instrument Markings (EASA CRI G-OI).

e) Aircraft Environmental Standards:

Aircraft Noise:
AWM 516, Aircraft Emissions, at Change 516-10 published December 1, 2010 (Incorporating by reference International Civil Aviation Organization (ICAO) Annex 16, Amendment 9 to Volume I (Chapter 11 Helicopters - not exceeding 3,175 kg (7,000 lb) Maximum Certificated Take-off Mass)).

Aircraft Engine Emissions (Fuel Venting):
AWM 516.105, Vented Fuel Standards, at Change 516-10 published December 1, 2010 (Incorporating by reference, ICAO Annex 16, Volume II (Chapter 2 - Prevention of Intentional Fuel Venting)).

5.1.2 This Modification

The basis of certification for this modification has been considered in accordance with CAR 521.158 - Standards of Airworthiness, AC 521-004 and AC 500-16. The Changed Product Rule Decision Record, CPR-DR1009, Rev. 0 (Appendix B), documents the following findings with regards to this modification:

- this modification is not substantial
- the latest standards will not be used
- this change is not significant
- the basis of certification for this modification remains the same as the original basis of certification for the aircraft as defined in the TCDS.

5.2 Equivalency of Canadian Basis of Certification to Foreign Basis

This section addresses the basis of certification in foreign jurisdictions for which this approval may be familiarized following issue of the Canadian approval.

5.2.1 FAA – TCDS H9EU, Revision 23

The certification basis is as follows (EC130 T2, most recent):

14 CFR 21.29 and part 27 Amendment 27-1 through Amendment 27-32, 27.1317 at Amendment 27-42.

14 CFR 36 Appendix H through Amendment 20.

Special Condition 27-009-SC for HIRF.

Equivalent Level of Safety Findings

- 14 CFR 27.1549(b) Powerplant Instrument Markings

- 14 CFR 27.1027(b)(2) Main Gearbox Oil Filter Bypass

The Canadian basis of certification defined on TCDS H-83 is equivalent to the FAA basis of certification defined on TCDS H9EU, as indicated by the included technical standards of FAR 27 at the same amendment as referenced in the Canadian basis of certification.

5.2.2 EASA – TCDS R.008, Issue 8

JAR 27 first issue dated September 6, 1993, and orange paper amendment 27/98/1 effective February 16, 1998.

The Canadian basis of certification defined on TCDS H-83 is equivalent to the EASA basis of certification defined on TCDS R.008, as stated on TCDS H-83.

6.0 APPLICABILITY OF AIRWORTHINESS DIRECTIVES

Airworthiness Directives applicable to the Airbus Helicopters EC130 B4 and EC130 T2 were reviewed on 01 February 2015, and none were found to be affected by this project.

7.0 CERTIFICATION PLAN

7.1 General

Re-issue of the approval is to accomplish the following:

a) Add quick release mounting provisions configuration for EC130 models (1009 configuration)

b) Add cargo basket configuration for EC130 models (1009 configuration).

c) Add bicycle rack configuration for EC130 models (1002 configuration).

d) Add cabin step configuration for EC130 models (1010 configuration).

This certification plan details the means and methods of compliance for the addition of the new configurations listed above.

CAR 27 Subpart B - Flight

7.2 527.29 – Empty Weight and Corresponding C of G

7.2.1 Means of Compliance

a) Review, calculate and inspect

7.2.2 Method of Compliance

a) Weight and balance information required to compute the aircraft empty weight and corresponding C of G with the cargo basket, cabin steps and mounting provisions installed is provided on each installation drawing as well as in the Instructions for Continued Airworthiness.

7.2.3 Compliance Documents, Data and Testing

a) Installation drawings: 100202, 100901, 100902, 101001

b) Instructions for Continued Airworthiness ICA1002.91 Revision 0 (bike rack)

c) Instructions for Continued Airworthiness ICA1009.91 Revision 0 (basket, provisions)

d) Instructions for Continued Airworthiness ICA1010.91 Revision 0 (cabin step)

7.2.4 Level of Delegation

Finding of compliance to CAR 527.29 delegated.

7.2.5 Level of Involvement / Service

None

7.3 527.45, .51, .65, .71, .73, .75, .141, .143, .171, .173, .175, .177, .241, .251, .547 – Flight Requirements

7.3.1 Means of Compliance

a) Test

7.3.2 Method of Compliance

a) Company flight test to ensure installations do not produce excessive vibration and determine the handling qualities of the aircraft are adequate prior to TCCA flight test.
b) Comprehensive TCCA flight tests to determine flight characteristics and limitations.

7.3.3 Compliance Documents, Data and Testing

a) Flight test plan and report FTP1009.03.
b) Flight test report prepared by TCCA flight test pilot

7.3.4 Level of Delegation

Not delegated

7.3.5 Level of Involvement / Service

a) TCCA to accept flight test plan FTP1009.03.
b) TCCA Flight test
c) Finding of compliance for flight requirements paragraphs

Subpart C – Strength Requirements

7.4 527.301, .303, .305, .307, .337, .625 – Strength Requirements

7.4.1 Means of Compliance

a) Analysis
b) Test

7.4.2 Method of Compliance

a) Analysis to determine applied loads
b) Analysis and load tests to show proof of compliance

7.4.3 Compliance Documents, Data and Testing

a) Engineering Reports: ER1002.01, ER1009.01, ER1010.01
b) Load Test Reports: TR1002.02, TR1009.02, TR1010.02

7.4.4 Level of Delegation

a) Finding of compliance to CAR 527.301, .303, .305, .307, .337, .561 delegated.

7.4.5 Level of Involvement / Service

a) TCCA to accept air drag loads in ER1002.01, ER1009.01, ER1010.01
b) TCCA to accept load test plans TR1002.02, TR1009.02, TR1010.02.

Subpart D – Design and Construction

7.5 527.601, .603, .605, .609, .611 – Design Requirements

7.5.1 Means of Compliance

a) Review and inspect

7.5.2 Method of Compliance

a) Specifications on fabrication drawings

7.5.3 Compliance Documents, Data and Testing

a) Fabrication drawings

7.5.4 Level of Delegation

a) Finding of compliance to CAR 527.601, .603, .605, .609, .611 delegated.

7.5.5 Level of Involvement / Service

None.

7.6 527.613 – Material Requirements

7.6.1 Means of Compliance

a) Analysis

7.6.2 Method of Compliance

a) Strength properties in accordance with material specifications and AR-MMPDS-01 as applicable

7.6.3 Compliance Documents, Data and Testing

a) Fabrication drawings

7.6.4 Level of Delegation

a) Finding of compliance to CAR 527.613 delegated.

7.6.5 Level of Involvement / Service

None.

7.7 527.783, .807 – Doors / Emergency Exits

7.7.1 Means of Compliance

a) Review and inspect.

7.7.2 Method of Compliance

a) Statement in report regarding access to cabin doors

7.7.3 Compliance Documents, Data and Testing

a) Engineering Reports ER1002.01, ER1009.01

7.7.4 Level of Delegation

a) Finding of compliance to CAR 527.807 delegated.

7.7.5 Level of Involvement / Service

a) Finding of compliance to CAR 527.783.

7.8 527.787 – Cargo Compartments

7.8.1 Means of Compliance

a) Analysis

7.8.2 Method of Compliance

a) Compliance with CAR 527.301 through 527.307 and 527.337

7.8.3 Compliance Documents, Data and Testing

a) Engineering Report ER1009.01
b) Load Test Report TR1009.02
c) Fabrication drawings

7.8.4 Level of Delegation

a) Finding of compliance to CAR 527.787 delegated.

7.8.5 Level of Involvement / Service

None.

CAR 29 Subpart G – Operating Limitiations and Information

7.9 527.1505, .1525, .1581, .1583(c), .1585, .1587

7.9.1 Means of Compliance

a) Test
b) Flight Manual Supplement

7.9.2 Method of Compliance

a) TCCA flight test to determine limitations
b) Flight Manual Supplement provided which includes operating limitations, operating procedures, performance information and loading information.

7.9.3 Compliance Documents, Data and Testing

Flight Manual Supplement FMS1009.91

7.9.4 Level of Delegation

None

7.9.5 Level of Involvement / Service

a) TCCA to approve FMS1009.91
b) Finding of compliance to CAR 527.1505, .1525, .1581, .1583(c), .1585, .1587

7.10 527.1557 – Markings and Placards

7.10.1 Means of Compliance

a) Placard provided

7.10.2 Method of Compliance

a) Placard specifies loading limitations

7.10.3 Compliance Documents, Data and Testing

a) Fabrication drawings

7.10.4 Level of Delegation

a) Finding of compliance to CAR 527.1557 delegated.

7.10.5 Level of Involvement / Service

None.

7.11 527.1529 - ICA

7.11.1 Means of Compliance

b) Instructions for Continued Airworthiness provided

7.11.2 Method of Compliance

b) Instructions for Continued Airworthiness are prepared in accordance with CAR 527 Appendix A

7.11.3 Compliance Documents, Data and Testing

Instructions for Continued Airworthiness ICA1002.90, ICA1009.90, ICA1010.90

7.11.4 Level of Delegation

None

7.11.5 Level of Involvement / Service

a) TCCA to accept ICA1002.90, ICA1009.90, ICA1010.90

b) Finding of compliance to CAR 527.1529

7.12 Schedule

The following schedule is proposed and will be updated as items are changed or completed.

Proposed target completion date: 01 June 2015

Item	**Deliverable**	**TCCA Level of Involvement / Service**	**Submission Date (proposed)**	**Approval / Acceptance (initial)**	**Date**
Flight test plan (Section 7.3.5)	FTP1009.03	Accept test plan			
Flight test report (Section 7.3.5)	FTP1009.03	Accept results			
TCCA Flight test (Section 7.3.5)	Report	Flight test by TCCA pilot	N/A		
Engineering Report – Air Drag Loads (Section 7.4.5)	ER1002.01	Accept air drag loads			
	ER1009.01	Accept air drag loads			
	ER1010.01	Accept air drag loads			
Load test report (Section 7.4.5)	TR1002.02	Accept test plan			
	TR1009.02	Accept test plan			
	TR1010.02	Accept test plan			
Engineering Report (Section 7.7.5)	ER1002.01	Finding of compliance to CAR 527.783			
	ER1009.01				
Flight Manual Supplement (Section 7.9.5)	FMS1009.91	Review and approval			
ICA (Section 7.11.5) (MSI 53)	ICA1002.90	Review and acceptance			
	ICA1009.90	Review and acceptance			
	ICA1010.90	Review and acceptance			
Findings of Compliance (Section 7.3.5, 7.7.5, 7.9.5, 7.11.5)	CP1009 (checklist)	Finding of compliance to indicated paragraphs on compliance program checklist (Appendix A)			

APPENDIX A

COMPLIANCE PROGRAM CHECKLIST

APPLICANT:	Aero Design Ltd. 9888 A Malaspina Road Powell River, BC, Canada V8A 0G3	DATE:	08 February 2015
		REVISION No.	0
		MAKE:	Airbus Helicopters
CORRESPONDANCE TO: (If other than applicant)		MODEL:	EC130 B4, EC130 T2
		REGISTRATION:	All Eligible
		SERIAL No.:	All Eligible

NATURE OF WORK: Quick Release Mounting Provisions Installation; Quick Release Cargo Basket Installation; Quick Release Bike F Installation; Quick Release Cabin Step Installation

TYPE CERTIFICATE DATA SHEET: H-83

MODEL CERTIFICATION BASIS: AWM 527 at Change 527-3 (EC130 T2 Certification Basis)

MODIFICATION CERTIFICATION BASIS: AWM 527 at Change 527-3 (EC130 T2 Certification Basis)

Airworthiness Requirement	AWM 527 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
Subpart B - Flight						
527.29	3	Empty Weight and Corresponding C of G	Data specified on inst'n drawing		X	
527.45	3	Performance - General	Flight Test	X		Preliminary flight tests performed by Aero Design in accordance with Flight Test Plan FTP1009.03 Certification flight tests performed by TCCA test pilot
527.51	3	Takeoff data: General	Flight Test	X		
527.65	3	Climb: All Engines Operating	Flight Test	X		
527.71	3	Autorotation Performance	Flight Test	X		
527.75	3	Landing	Flight Test	X		
527.141	3	Flight Characteristics – General	Flight Test	X		
527.143	3	Controllability and Maneuverability	Flight Test	X		
527.171	3	Stability – General	Flight Test	X		
527.173	3	Static Longitudinal Stability	Flight Test	X		
527.175	3	Demonstration of Longitudinal Stability	Flight Test	X		
527.177	3	Static Directional Stability	Flight Test	X		
527.241	3	Ground Resonance	Flight Test	X		
527.251	3	Vibration	Flight Test	X		

Airworthiness Requirement	AWM 527 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
Subpart C – Strength Requirements						
527.301	3	Loads – Air Drag Loads	Analysis	X		
527.301	3	Loads – Inertia Loads	Compliance with 527.337 and 527.561		X	
527.303	3	Factor of Safety	Analysis		X	
527.305	3	Strength and Deformation	Analysis and Test iaw Test Plans		X	
527.307	3	Proof of Structure	Analysis and Test iaw Test Plans		X	
527.337(a)	3	Limit Maneuvering Load Factor	Analysis and Test iaw Test Plans		X	Critical load factor in vertical direction.
527.547	3	Main Rotor Structure	Flight Test	X		
527.561(b)(3)	3	Occupant Protection	N/A			Not an item of mass inside the cabin
527.561(c)	3	Items of Mass	N/A			Basket and bike rack are not loca above/behind the cabin. Forward deflection or failure of basket bike rack poses no threat to occupants cabin. 527.337 Maneuvering Loads are crit vertical loads.
527.561(d)	3	Internal fuel tanks	N/A			Installation not in area of internal fuel ta below the passenger floor
Subpart D – Design and Construction						
527.601	3	Design	Drawings		X	Design is conventional.
527.603	3	Materials	Drawings		X	Materials as specified in AR-MMPDS-01
527.605	3	Fabrication Methods	Drawings		X	Design is conventional.
527.609	3	Protection of Structure	Drawings		X	
527.611	3	Inspection Provisions	Drawings		X	Design is easy to inspect.
527.613	3	Material Strength Properties and Design Values	Values used as per AR-MMPDS-01		X	
527.625	3	Fitting Factor	Analysis		X	

Airworthiness Requirement	AWM 527 Amdt.	Subject for Compliance or Documentary Proof	Form of Substantiation	DOT	DAR	Comments
527.783	3	Doors	Statement in report	X		Cargo basket located is below doors. Bike rack is located aft of cabin doors.
527.787(a)	3	Cargo and Baggage Compartments	Compliance with 23.301 through 307		X	
527.787(b)	3	Cargo and Baggage Compartments	Design		X	Basket is a closed container.
527.787(c)(1)	2	Cargo and Baggage Compartments	Statement in report		X	Cargo is external to helicopter, position not restrict escape facilities
527.807	2	Emergency Exits	Statement in report		X	Installation does not block doors form open
527.1387	9	Position Light System Dihedral Angles	N/A – statement in report			No change from Type Approval.
527.1401	11	Anticollision Light System	N/A – statement in report			No change from Type Approval.
Subpart G – Operating Limitations and Information						
527.1505	3	Never Exceed Speed	Flight Test, Flight Manual Supplement	X		V_{NE} limits to be determined by flight test
527.1525	2	Kinds of Operation	Flight Manual Supplement	X		Limited to VFR only.
527.1529	2	Instructions for Continued Airworthiness	ICA Provided	X		
527.1557(a)	2	Miscellaneous Markings and Placards – Baggage Compartments	Placard on lid		X	
527.1581	15	Rotorcraft Flight Manual – General	Flight Manual Supplement	X		
527.1583(c)	2	Operating Limitations – Weight and Loading Information	Flight Manual Supplement	X		
527.1585	2	Operating Procedures	Flight Manual Supplement	X		
527.1587	2	Performance Information	Flight Manual Supplement	X		
527.1589	2	Loading Information	Flight Manual Supplement & Placard	X		Placard installed on basket lid

APPENDIX B

CHANGED PRODUCT RULE DECISION RECORD

CARGO SWING INST, FP

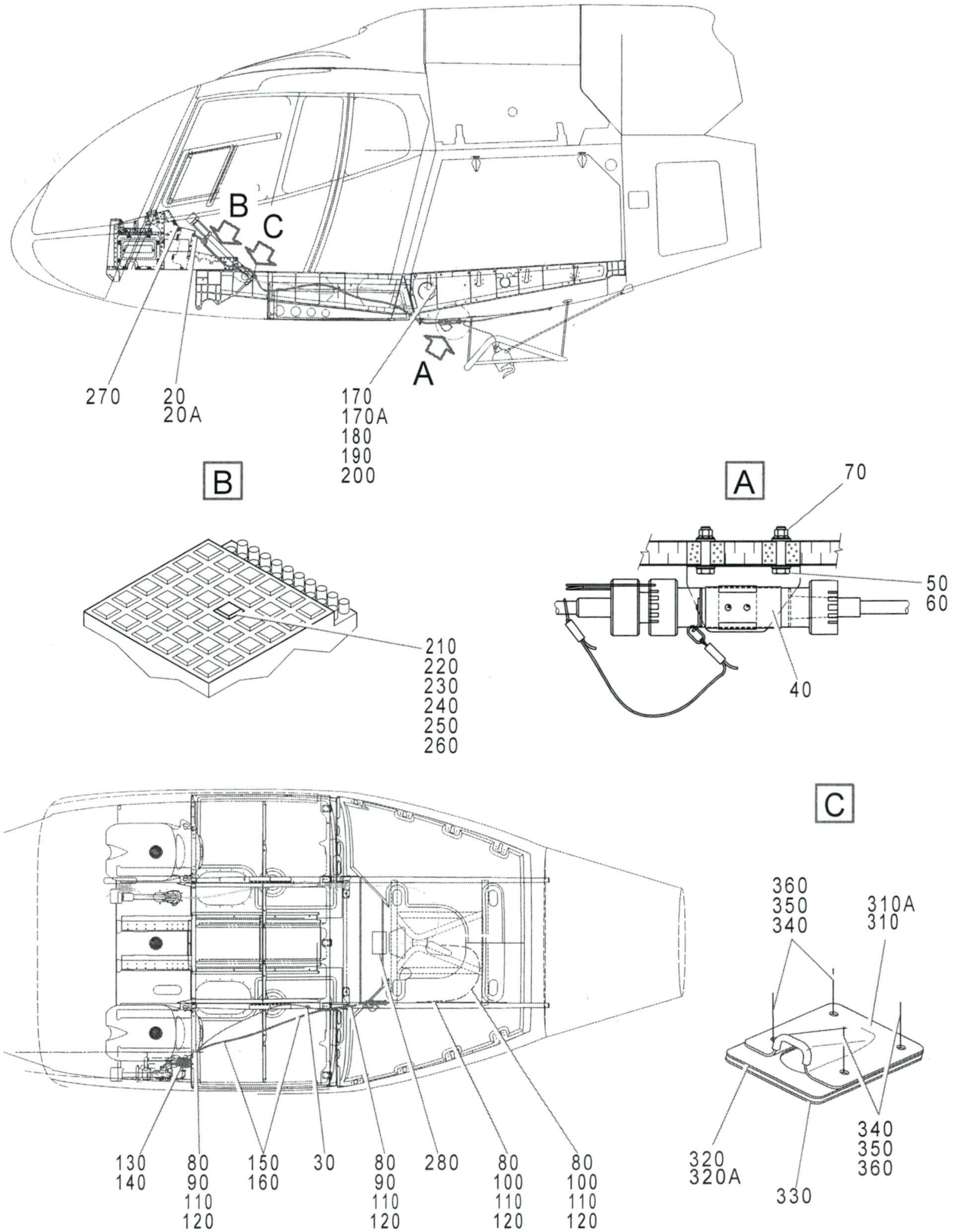
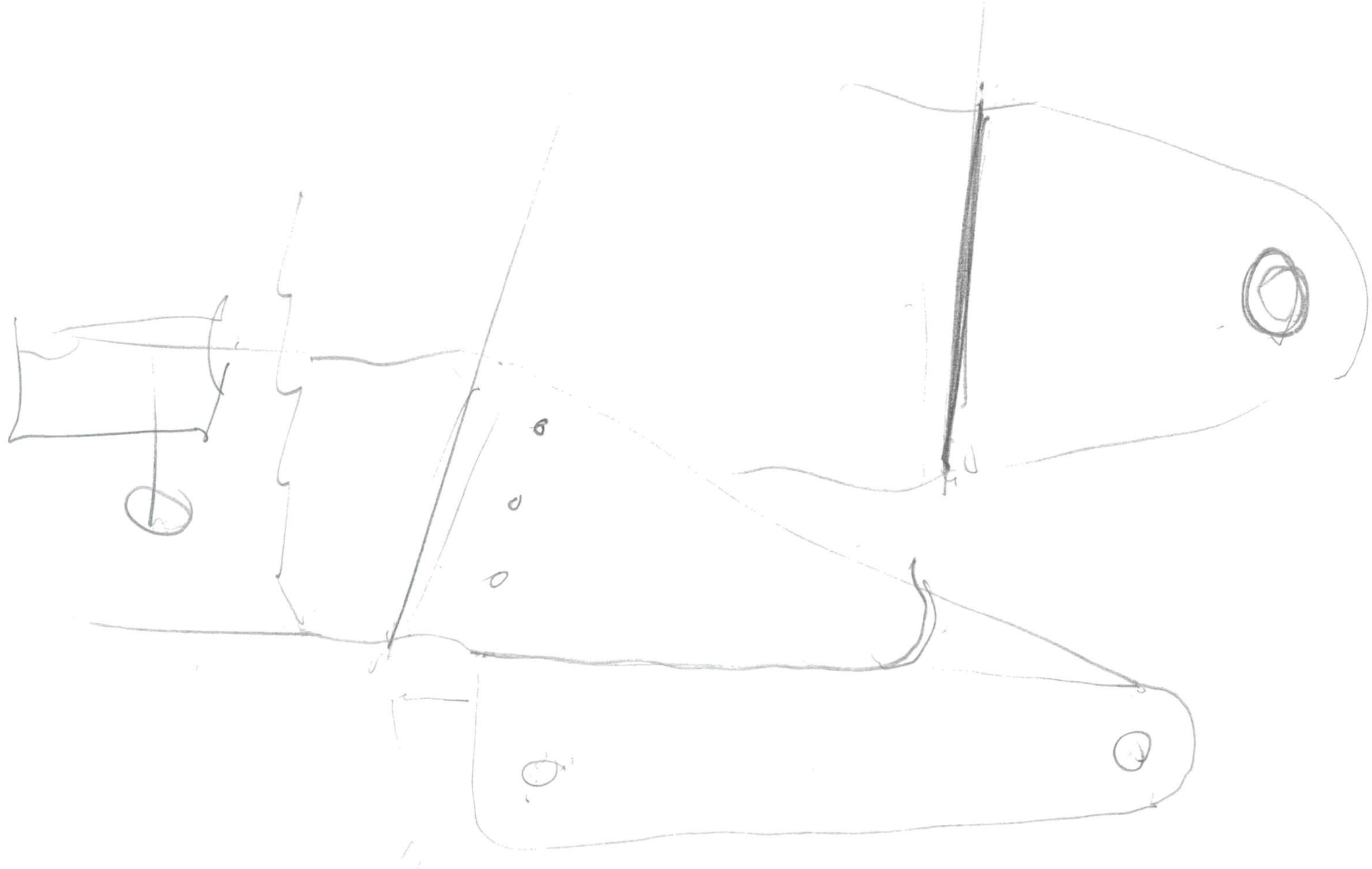


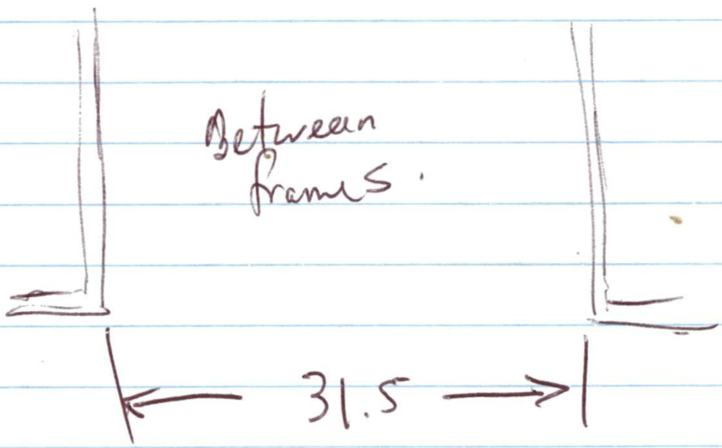
FIG.ITEM	CODE ENT. FSCM	MANUFACTURER PART NUMBER	DESCRIPTION 1234567	QTY ASSY
01 - 1 For A/C : 3363 3500 3521	+		CARGO SWING INST, FP AFTER AMENDMENT OP2914	REF
01 - 1A For A/C : 3514 3536 3539 3541 3560 3562 3565 3609 3614 3633 3642 3659 3662 3667 3681 3684 3691 3694-3695 3703 3706 3718 3720 3740 3753-3754 3759 3762 3768 3770 3772 3809	+		CARGO SWING (FP) AFTER AMENDMENT 07 3751	REF
01 - 1B For A/C : 3841 3862 3866 3914 3922	+		CARGO SWING (FP)	REF
01 - 1C For A/C : 3954 3967-3968 3992	+		CARGO SWING INST, FP	REF
01 - 1D For A/C : 4027 4032 4041 4051 4070 4100 4165 4192 4211 4224 4245 4294 4318 4336 4351 4361 4391 4407 4423 4463 4486 4495 4499	+		CARGO SWING (FP)	REF
01 - 1E For A/C : 4506 4531 4566 4580 4619 4628	+		CARGO SWING (FP)	REF R
20	F0309	AS22-24	. CONTROL,MECHANICAL,SLING APPLIC FOR NHA 1 APPLIC FOR NHA 1A APPLIC FOR NHA 1B APPLIC FOR NHA 1C APPLIC FOR NHA 1D WITH VENDOR DOC	1
20A	F0542	AS22-79	. MECHANICAL ORDER OF DROPPING APPLIC FOR NHA 1E AFTER AMENDMENT 07 3281	1
30	F0210	350A86-4000-22	. AUXILIARY JETTISON HANDLE	1
40	F0210	350A86-1051-00	. BRACKET EQUIPED	1
			------ Attaching parts ------	
50	F0111	22125BC050022L	. SCREW	AR
60	F0111	23111AG050LE	. WASHER	AR
70	F5442	ASN52320BH050N	. NUT	AR R
			---------*---------	
80	F5442	ASNA0021-21G06	. CLAMP	AR
			------ Attaching parts ------	
90	F0111	22125BC050012L	. SCREW	AR
100	F0111	22125BC050022L	. SCREW	AR
110	F0111	23111AG050LE	. WASHER	AR
120	F5442	ASN52320BH050N	. NUT	AR R
			---------*---------	
130	F0210	DHS751-160.14	. GROMMET	1
140	F0210	DHS751-160.56	. GROMMET	1
150	F5442	E0688-02	. SPACER	2
160	F5442	E0043-6C0	. CLAMP	4
170	F0210	341A66-1166-03	. PLUG ASSY APPLIC FOR NHA 1	1

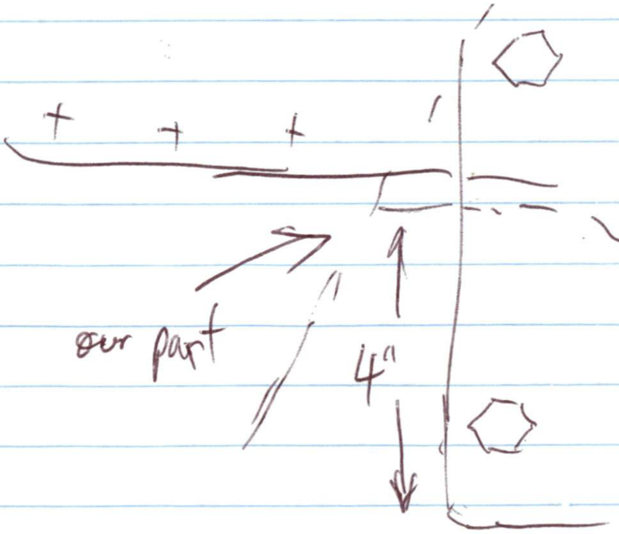
170A	F0210	341A66-1166-01	. PLUG ASSY APPLIC FOR NHA 1A APPLIC FOR NHA 1B APPLIC FOR NHA 1C APPLIC FOR NHA 1D APPLIC FOR NHA 1E AFTER AMENDMENT 07 3751	1
180	F0111	22272BC030010L	. SCREW	4
190	F0111	23111AG030LE	. WASHER	4
200	F5442	ASN52320BH030N	. NUT	4
210	F0210	DHS775-160.42	. BODY,LIGHT APPLIC FOR NHA 1 APPLIC FOR NHA 1A AFTER AMENDMENT 07 3537	1
220	F0210	DHS775-240.22	. CAP APPLIC FOR NHA 1 APPLIC FOR NHA 1A AFTER AMENDMENT 07 3537	1
230	I9005	EN2240-6839	. BULB APPLIC FOR NHA 1 APPLIC FOR NHA 1A AFTER AMENDMENT 07 3537	4
240	F0210	350A61-1726-51	. LABEL,"ELING" FRENCH APPLIC FOR NHA 1 APPLIC FOR NHA 1A AFTER AMENDMENT 07 3537	1
250	F0210	350A61-1726-91	. LABEL,"SLING" ENGLISH APPLIC FOR NHA 1 APPLIC FOR NHA 1A AFTER AMENDMENT 07 3537	1
260	F0210	350A61-1726-BM	. LABEL (GERMAN) APPLIC FOR NHA 1 APPLIC FOR NHA 1A AFTER AMENDMENT 07 3537	1
270	F0210	DHS811-251.20	. PLATES,NAME,EXTERNAL LOADS (CLASS B)	1
280	F0210	350A00-0122-62	. LABEL	1
- 290			. LOADMETER SLING, INST APPLIC FOR NHA 1 FOR DETAIL SEE 25-91-01-03-1	1
- 290A			. LOADMETER SLING, INST APPLIC FOR NHA 1A APPLIC FOR NHA 1B APPLIC FOR NHA 1C APPLIC FOR NHA 1D APPLIC FOR NHA 1E FOR DETAIL SEE 25-91-01-03-1A AFTER AMENDMENT 07 3751	1
- 300			. CARGO SWING WIRING APPLIC FOR NHA 1 FOR DETAIL SEE 88-25-91-01-1	1
- 300A			. CARGO SWING WIRING APPLIC FOR NHA 1A FOR DETAIL SEE 88-25-91-01-1A	1
- 300B			. CARGO SWING WIRING APPLIC FOR NHA 1B FOR DETAIL SEE 88-25-91-01-1B	1

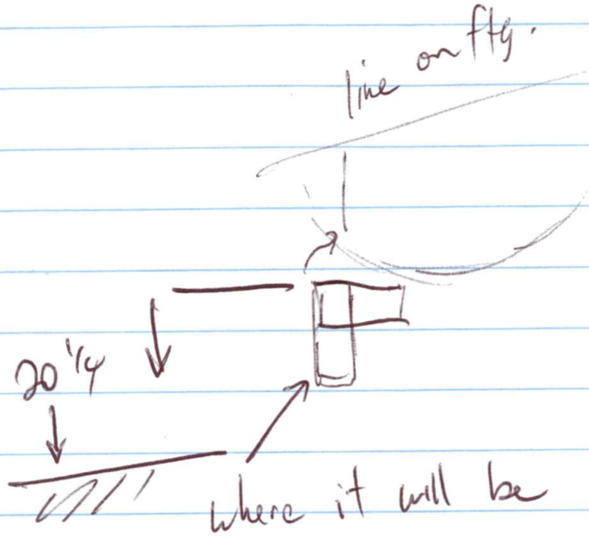
- 300C			. CARGO SWING WIRING APPLIC FOR NHA 1C APPLIC FOR NHA 1D APPLIC FOR NHA 1E FOR DETAIL SEE 88-25-91-02-1 AFTER AMENDMENT OP 3218	1
310	F0210	350A86-4005-01	. COVER APPLIC FOR NHA 1D	1
310A	F0210	350A86-4005-02	. COWLING EQUIPPED PROTECTOR APPLIC FOR NHA 1E AFTER AMENDMENT 07 3281	1
320	F0210	350A86-4005-21	. REINFORCEMENT PLATE APPLIC FOR NHA 1D	1
320A	F0210	350A86-4005-25	. REINFORCING PLATE APPLIC FOR NHA 1E AFTER AMENDMENT 07 3281	1
330	F0210	350A86-4005-22	. PLATE APPLIC FOR NHA 1D APPLIC FOR NHA 1E AFTER AMENDMENT 07 3795	1
340	F0111	22272BC040014L	. SCREW APPLIC FOR NHA 1D APPLIC FOR NHA 1E AFTER AMENDMENT 07 3795	4
350	F0111	23111AG040LE	. WASHER APPLIC FOR NHA 1D APPLIC FOR NHA 1E AFTER AMENDMENT 07 3795	8
360	F5442	ASN52320BH040N	. NUT APPLIC FOR NHA 1D APPLIC FOR NHA 1E	4
- 370	F5442	E0043-6C0	. CLAMP APPLIC FOR NHA 1E AFTER AMENDMENT 07 3281	6

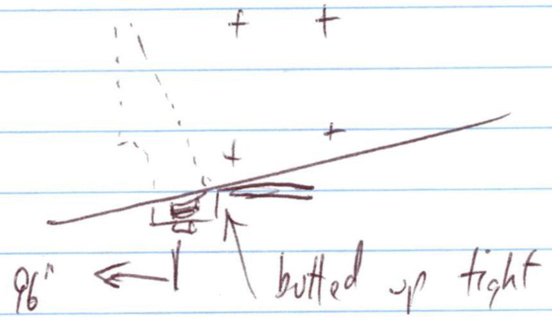
- ITEM NOT ILLUSTRATED

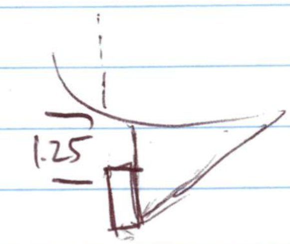



Between
frames.
31.5

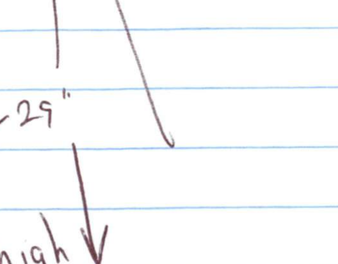

jeggle 1/16"
our part
4"

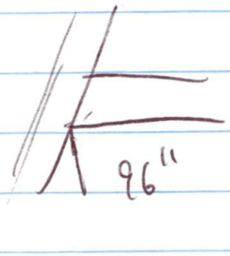






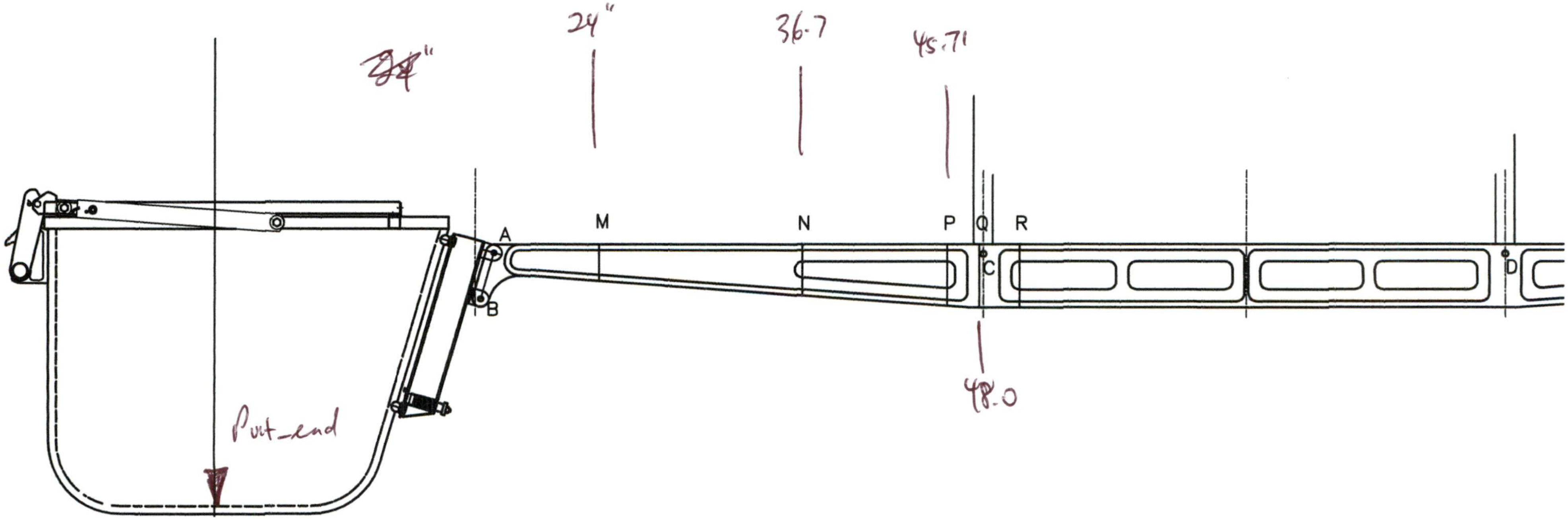
not sure if panel will
Close



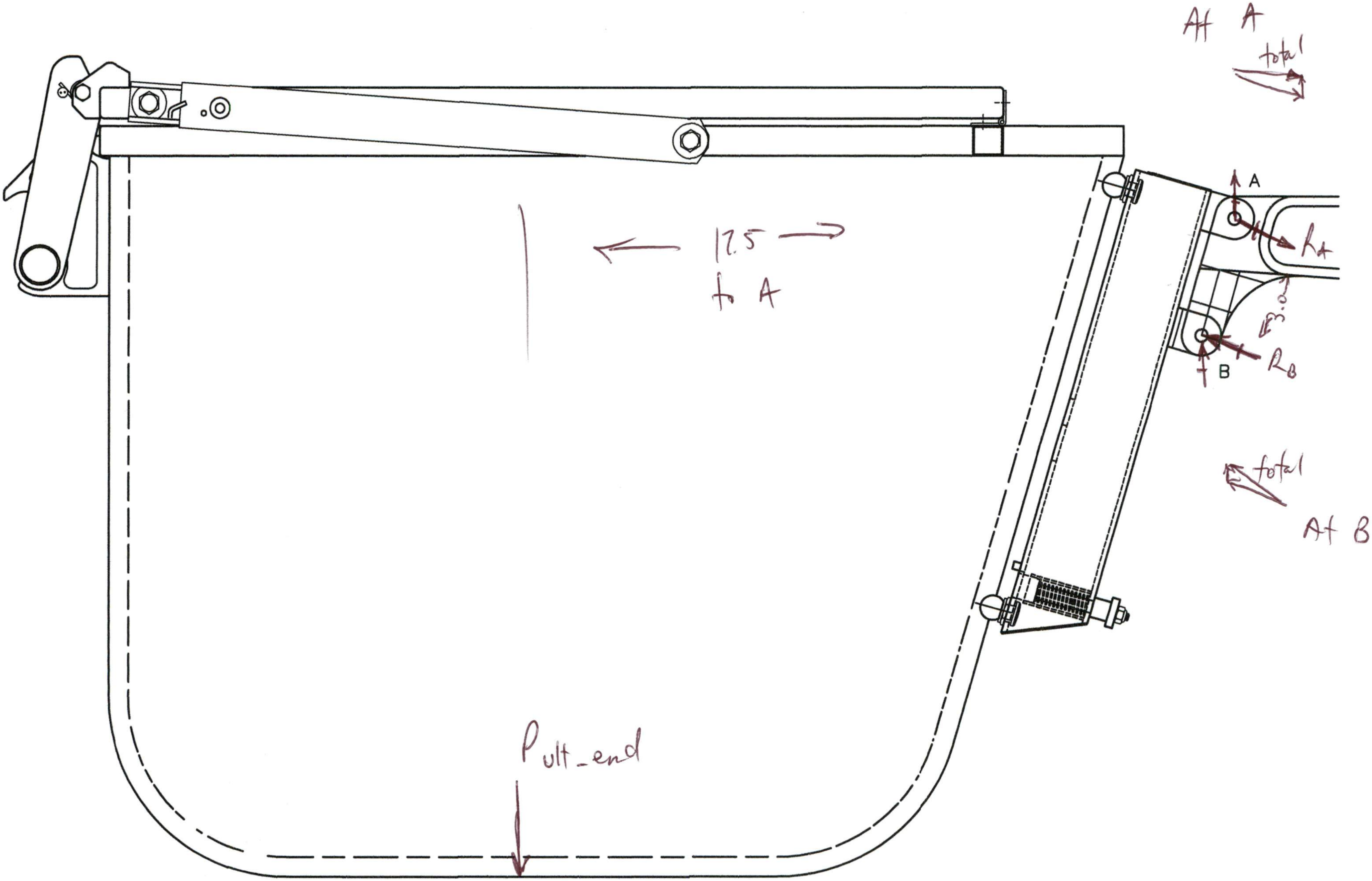


* too high
not enough clearance for doors

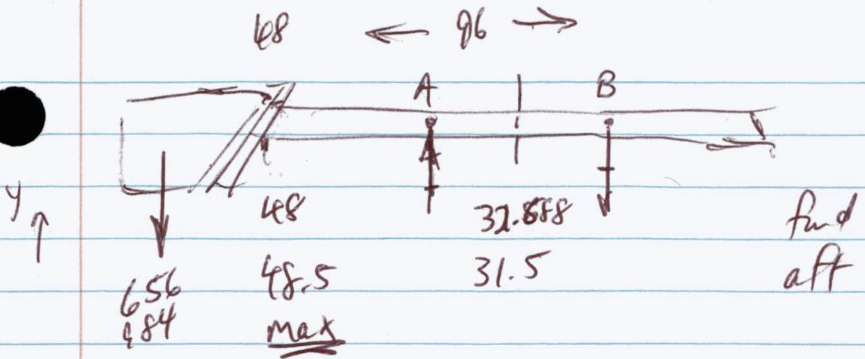
does clear under Dart checks

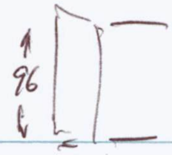


~~24"~~
24"
36.7
45.71
A
M
N
P
Q
R
B
C
D
48.0
Pivot_end



At A
total
A
R_A
3.0
R_B
B
total
At B
12.5
to A
P_{ult_end}





$P = 300 \qquad w = 75 \qquad P_{end} = 375/2 = 187.5$

lim $= 656.25$
ult $= 984.4$

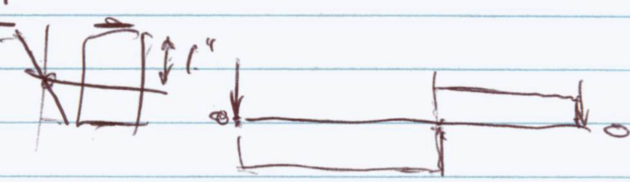
$\Sigma M_A = 0 \qquad \dfrac{656 \times 48.5}{31.5} = R_B$

$R_B = 1010.4$ lim $\qquad$ 1516 ult

$\Sigma F_y = 0 \qquad R_A = P + R_B$
$= 656 + 1010$
$= 1667$ lb. lim $\qquad$ 2500 ult

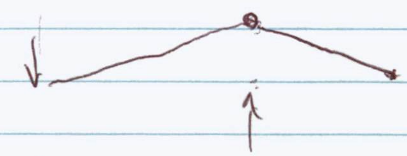
1x2 $\quad f_b = \dfrac{My}{I} = \dfrac{(984.4 \times 48) \times 1}{0.28}$

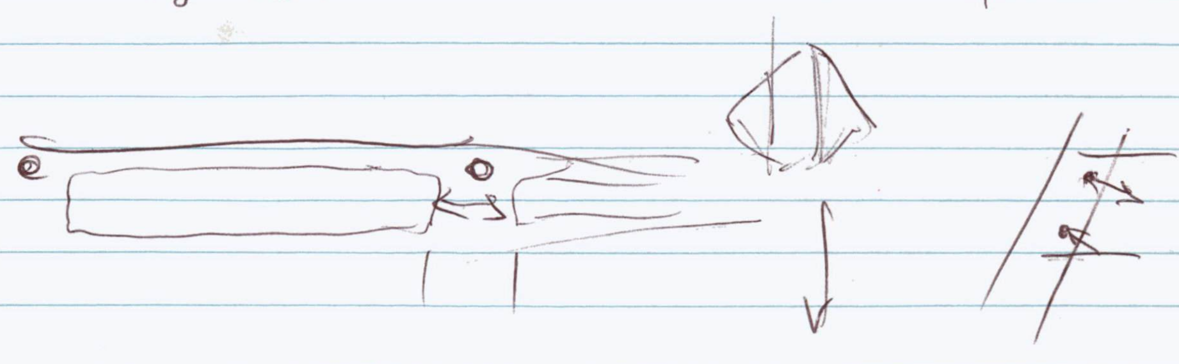
$f_b = 163$ ksi
70/80 ksi



1x3 $\quad f_b = \dfrac{984.4 \times 48 \times 1.5}{0.817}$

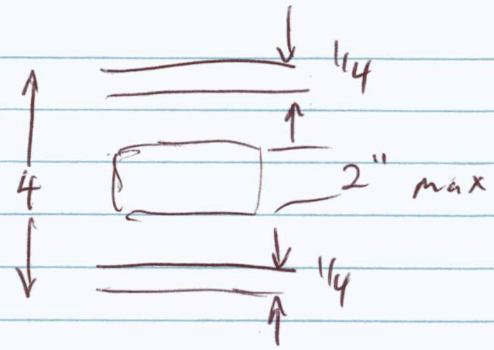
$f_b = 55.7$ ksi





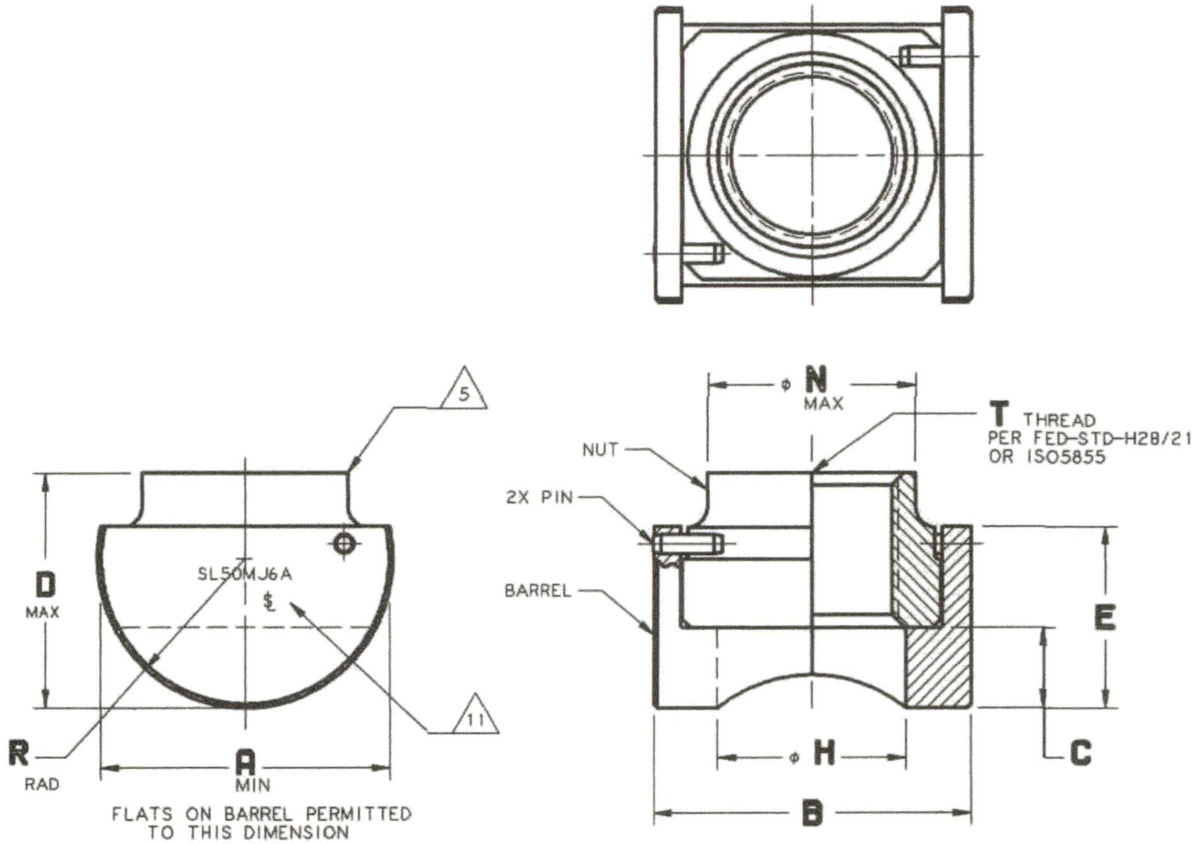
$$984.4 \times 48 = \frac{47257.2 \times 2}{2.507} = 37.7 \text{ ksi}$$

@ lightening holes



$$\frac{47257.2 \times 2}{2.667}$$

=



NOTES:

1. MATERIAL: SEE TABLE II
2. HEAT TREAT: SEE TABLE II
3. FINISH: SEE TABLE III
4. NUT FLOAT IN CRADLE:
   TRANSVERSE - .028 [0.71]MINIMUM
   LENGTHWISE - PERMISSIBLE BUT NOT REQUIRED

5. NUT SHANK DEFORMED IN THIS AREA TO PROVIDE LOCKING TORQUES PER LN65016.

6. MAGNETIC PARTICLE INSPECT PER ASTM E1444.

7. THE AXIAL TENSILE STRENGTHS SHOWN IN TABLE I SHALL BE MET WITH THE NUT ASSEMBLY INSTALLED IN A CLOSE FITTING STEEL JIG (HARDNESS 41 HRC MIN) WITH A HOLE NO LARGER THAN .003 [0.08] OVER 2 TIMES THE *MAXIMUM "A" RADIUS AND TESTED WITH A BOLT* OF SUFFICIENT STRENGTH TO CAUSE STRIPPING OF THE NUT THREADS.

8. THE AXIAL TENSILE STRENGTHS SHOWN IN TABLE I HAVE BEEN CALCULATED USING THE TENSILE STRENGTHS OF 180 KSI UTS MIN (1250 MPa) BOLTS. THE CALCULATIONS ARE BASED ON THE FORMULA FOUND IN ANSI B1.1-1989 (FED-STD-H28) WHICH USES THE BASIC PITCH DIAMETER OF THE THREAD.

9. THESE PARTS ARE INTENDED FOR USE WITH 180 KSI [1241 MPa] UTS BOLTS.

10. REFER TO DRAWING SLR50M FOR RETAINERS TO BE USED WITH THESE NUT ASSEMBLIES

11. MARKING: MARK SHUR-LOK PART NUMBER AND LOGO LASER MARKED PER AS478, METHOD 15B1 OR 15B2.

12. AVAILABLE IN METRIC "M" THREADS.

EXAMPLE OF PART CODING

SL50MJ 10 A N

- CODE "N" INDICATES NO THREAD LOCK. OMIT CODE LETTER FOR A THREAD LOCKED PART
- FINISH CODE (SEE TABLE II. SHEET 2)
- SIZE CODE (SEE TABLE I. SHEET 2)
- BASIC PART NUMBER

REVISION (A) 27FEB02

UNLESS OTHERWISE SPECIFIED
INTERPRET DIMENSIONS & TOLERANCES PER ANSI Y14.5M ALL DIMENSIONS APPLY AFTER PLATING AND PRIOR TO THE ADDITION OF SOLID FILM LUBRICANT. 125 [3.2] ✓ ALL SURFACES

TOLERANCES

XX	XXX	ANGLES	[X.X]	[X.XX]
±.03	±.010	±2°	±[0.8]	±[0.25]

DIMENSIONS IN [ ] ARE MILLIMETERS

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SHUR-LOK

SHUR-LOK INTERNATIONAL, S.A.
PETIT-RECHAIN, BELGUIM
TELEPHONE: (32) 87-32.07.11

BARREL NUT, SELF LOCKING, FLOATING, 180 KSI [1241 MPa]

SL50MJ

SHEET 1 OF 2

TABLE I

SIZE CODE	T THREAD PER FED-STD-H28/21 OR ISO5855	A MIN	B	C ±.005 ±[0.13]	D MAX	E +.000 -.010 +[0.00] -[0.25]	ϕ H +.010 -.000 +[0.25] -[0.00]	R RAD +.0015 -.0000 +[0.040] -[0.000]	N MAX	AXIAL TENSILE STRENGTH MIN 8 LB [NEWTON]
6	MJ6 X 1.0-4H5H	.513 [13.03]	.625 [15.88]	.125 [3.18]	.406 [10.31]	.320 [8.13]	.268 [6.81]	.2625 [6.668]	.375 [9.52]	5,575 [24,799]
8	MJ8 X 1.0-4H5H	.575 [14.60]	.688 [17.48]	.125 [3.18]	.468 [11.89]	.360 [9.14]	.346 [8.79]	.2935 [7.455]	.406 [10.31]	10,900 [48,486]
10	MJ10 X 1.25-4H5H	.669 [16.99]	.750 [19.05]	.156 [3.96]	.531 [13.49]	.420 [10.67]	.425 [10.80]	.3405 [8.649]	.500 [12.70]	17,000 [75,620]
12	MJ12 X 1.25-4H5H	.857 [21.77]	1.000 [25.40]	.219 [5.56]	.703 [17.86]	.540 [13.72]	.504 [12.80]	.4345 [11.036]	.625 [15.88]	25,700 [114,319]
14	MJ14 X 1.5-4H5H	.950 [24.13]	1.094 [27.79]	.250 [6.35]	.765 [19.43]	.590 [14.99]	.583 [14.81]	.4810 [12.217]	.688 [17.48]	34,700 [154,353]
16	MJ16 X 1.5-4H5H	1.045 [26.54]	1.125 [28.57]	.281 [7.14]	.844 [21.44]	.650 [16.51]	.661 [16.80]	.5285 [13.424]	.750 [19.05]	46,700 [207,732]
18	MJ18 X 1.5-4H5H	1.263 [32.08]	1.500 [38.10]	.344 [8.74]	1.062 [26.97]	.750 [19.05]	.740 [18.80]	.6375 [16.192]	.875 [22.23]	60,400 [268,673]
20	MJ20 X 1.5-4H5H	1.418 [36.02]	1.531 [38.89]	.375 [9.53]	1.156 [29.36]	.850 [21.59]	.819 [20.80]	.7150 [18.161]	1.000 [25.40]	75,800 [337,175]
22	MJ22 X 1.5-4H5H	1.418 [36.02]	1.531 [38.89]	.375 [9.53]	1.156 [29.36]	.850 [21.59]	.898 [22.81]	.7150 [18.161]	1.000 [25.40]	93,100 [414,129]
24	MJ24 X 2.0-4H5H	1.544 [39.22]	1.728 [43.89]	.375 [9.53]	1.281 [32.54]	.880 [22.35]	.976 [24.79]	.7780 [19.761]	1.125 [28.58]	107,300 [477,294]

TABLE II

ITEM	MATERIAL	HEAT TREAT
NUT	4340 ALLOY STEEL PER AMS6414	PER AMS2759/1 OR AMS2759/2 TO MEET THE AXIAL TENSILE STRENGTHS AS SHOWN IN TABLE I.
BARREL		
PINS	300 SERIES CRES	NONE

TABLE III

FINISH CODE	FINISH	
	CRADLE	NUT
A	CADMIUM PLATE PER AMS-QQ-P-416, TYPE II, CLASS 2	CADMIUM PLATE PER AMS-QQ-P-416, TYPE II, CLASS 2 AND DRY-FILM LUBE PER AS5272, TYPE I
F	CADMIUM PLATE PER NAS672	CADMIUM PLATE PER NAS672

REVISION (A) 27FEB02

UNLESS OTHERWISE SPECIFIED INTERPRET DIMENSIONS & TOLERANCES PER ANSI Y14.5M. ALL DIMENSIONS APPLY AFTER PLATING AND PRIOR TO THE ADDITION OF SOLID FILM LUBRICANT 125 [3.2] ALL SURFACES
TOLERANCES .XX ±.03 .XXX ±.010 ANGLES ±2° [X.X] ±[0.8] [X.XX] ±[0.25]
DIMENSIONS IN [ ] ARE MILLIMETERS

SHUR-LOK CORPORATION IRVINE, CALIFORNIA 92614 TELEPHONE: (949) 474-6000
SHUR-LOK
SHUR-LOK INTERNATIONAL, S.A. PETIT-RECHAIN, BELGIUM TELEPHONE: (32) 87-32.07.11

BARREL NUT, SELF LOCKING, FLOATING, 180 KSI [1241 MPa]

SL50MJ

SHEET 2 OF 2

TABLE S2.1 Tensile Requirements (Round Annealed Condition)

Grade	Tensile Strength, min		Yield Strength, min		Elongation[A] in 2 in. or 50 mm, min, %
	ksi	MPa	ksi	MPa	
MT 429 and MT 430	60	414	35	241	20
MT-430-Ti	60	414	30	207	20
MT 304 L & MT 316 L	70	483	25	172	35
All other austenitic steels	75	517	30	207	35
MT 409	55	379	30	207	20
All other ferritic	60	414	35	241	20

[A] For longitudinal strip tests, the width of the gage section shall be 1 in. (25.4 mm) and a deduction of 1.75 percentage points for austenitic grades and 1.0 percentage points for MT 429 and MT 430 shall be permitted from the basic minimum elongation for each 1⁄32-in. (0.79-mm) decrease in wall thickness below 5⁄16 in. (7.94 mm).

S4. Test Reports

S4.1 Mill test reports will be furnished when specified in the order.

S4.2 When specified on the purchase order, or when a specific type of melting has been specified, the type of melting used to produce the material shall be included with the test report.

S5. Certification for Government Orders

S5.1 A producer's or supplier's certification shall be furnished to the government that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. This certificate shall include a report of heat analysis (product analysis when requested in the purchase order), and, when specified in the purchase order or contract, a report of test results shall be furnished.

S6. Rejection Provisions for Government Orders

S6.1 Each length of tubing received from the manufacturer may be inspected by the purchaser and, if it does not meet the requirements of the specification based on the inspection and test method as outlined in the specification, the tube may be rejected and the manufacturer shall be notified. Disposition of rejected tubing shall be a matter of agreement between the manufacturer and the purchaser.

S6.2 Material that fails in any of the forming operations or in the process of installation and is found to be defective shall be set aside, and the manufacturer shall be notified for mutual evaluation of the material's suitability. Disposition of such material shall be a matter for agreement.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this specification since the last issue, A554–10, that may impact the use of this specification. (Approved October 15, 2011)

(*1*) Revised 1.1.
(*2*) Added new keywords.
(*3*) Added ferritic grades to Supplemental Requirements in Table S1.1 and Table S2.1.

Committee A01 has identified the location of selected changes to this specification since the last issue, A554–08a, that may impact the use of this specification. (Approved April 1, 2010)

(*1*) Revised the P max allowable from 0.040 % to 0.045 % for alloys 301, 302, 304, 304L, 305, 309S, 309S-Cb, 310S, 316, 316L, 317, 321, and 347 in Table 1.

1. INTRODUCTION

The Dart D130-701-041 Heli-Utility-Basket™ mounts to the cargo swing fittings on the EC 130 B4 aircraft. The Dart D130-701-043 Heli-Utility Basket™ mounts to the airframe and allows the operator to install either the cargo swing or the single point cargo hook in conjunction with the basket. The D130-701-041/-043 Heli-Utility-Baskets™ are capable of carrying a distributed cargo load of 220 lb (100 kg). The D130-701-041/-043 kits can be installed on either the LH side or the RH side of the aircraft. It is also possible to install baskets on the LH and RH sides of the aircraft simultaneously.

The D130-701-011 Conversion kit allows the operator to convert the D130-701-041 Heli-Utility Basket installation to the D130-701-043 basket installation. The D130-701-013 Fixed Provisions allows the operator to mount a single D130-701-043 Heli-Utility-Basket™ on to several different aircraft.

The D130-701-043 Heli-Utility-Basket is also compatible with the D130-780-041/-042 Spacepods and the D130-780-011 Sliding Door Hinge Kit.

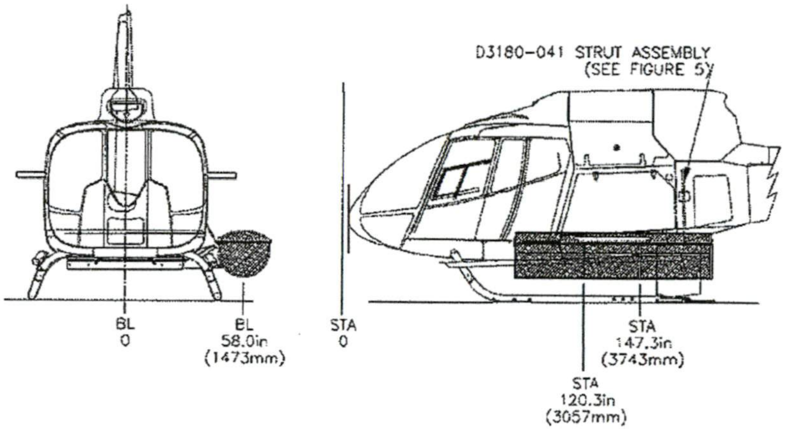

Figure 1 – D130-701-041 Heli-Utility-Basket™ Installation
(LH Installation Shown, RH Opposite)

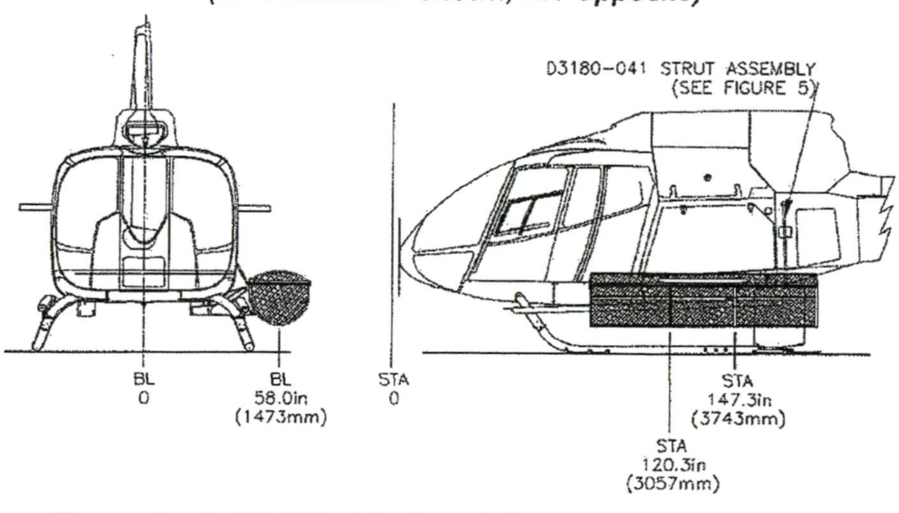

Figure 2 – D130-701-043 Heli-Utility-Basket™ Installation
(LH Installation Shown, RH Opposite)

DART AEROSPACE LTD.
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CANADA

Tel: 1 613 632 3336
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http://www.dartaero.com

INSTALLATION INSTRUCTIONS

IIN-D130-701

Heli-Utility-Basket™

EUROCOPTER EC 130 B4 MODELS

CANADA
DEPARTMENT OF TRANSPORT
AIRCRAFT CERTIFICATION
BRANCH
DAO # 01-O-01

APPROVED

BY: D. SHEPHERD (DE # 02)

DATE: JAN. 7, 2003
CERT. NO.: SH94-14
ISSUE NO.: ISSUE # 4

Prepared By: C. Provencal
Mechanical Designer

Checked By: D. Shepherd, P. Eng.
DE #02

Released By: D. Shepherd, P. Eng.
DE #02

REVISION RECORD

Revision	Issue Date	Description
A	02.12.06	New Issue
B	03.01.07	Add D3180-041; Change pip pin location

1. INTRODUCTION

The Dart D130-701-041 ***Heli-Utility-Basket™*** mounts to the cargo swing fittings on the EC 130 B4 aircraft. The D130-701-041 ***Heli-Utility-Basket™*** is capable of carrying a distributed cargo load of 220 lb (100 kg). The D130-701-041 kit can be installed on either the LH side or the RH side of the aircraft. It is also possible to install baskets on the LH and RH sides of the aircraft simultaneously.

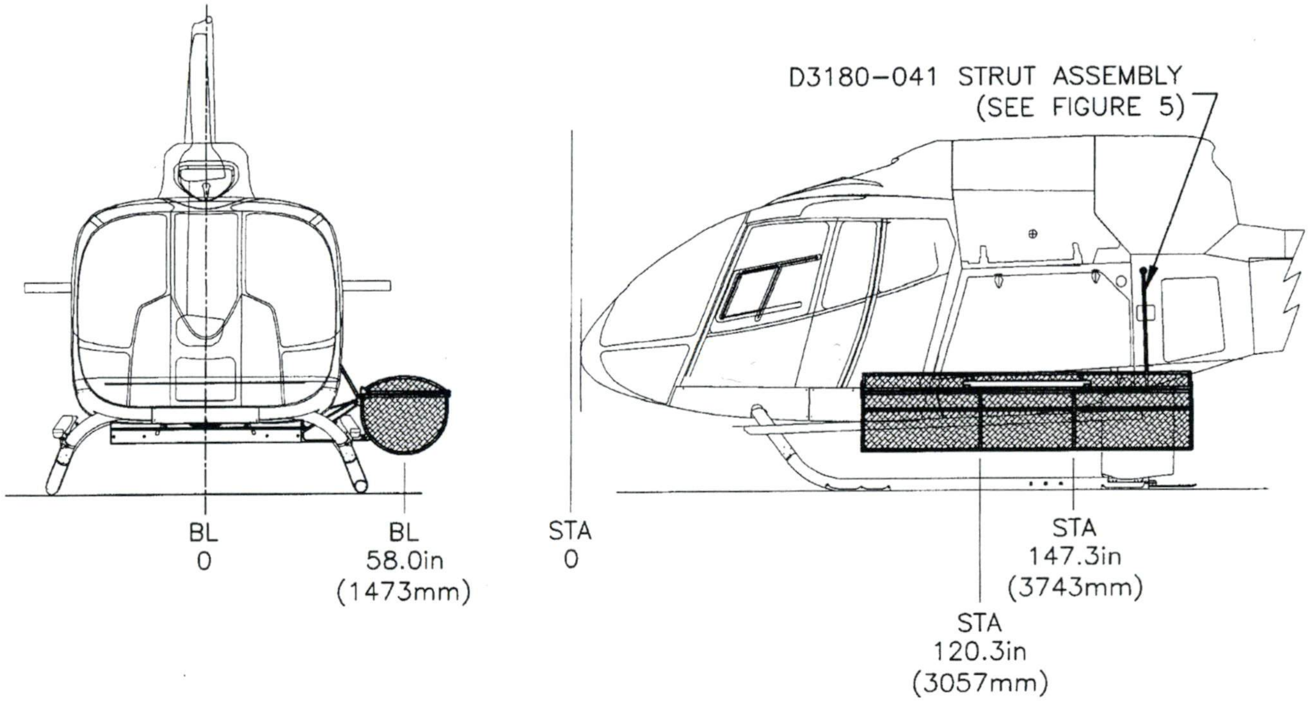


Figure 1 – D130-701-041 Heli-Utility-Basket™ Installation
(LH Installation Shown, RH Opposite)

2. GENERAL NOTES

COMPATIBILITY
Compatibility of this installation with the aircraft is the **responsibility of the installer.** Ensure that this installation does not conflict with a previous modification.

CONTINUING AIRWORTHINESS
This installation should be maintained in accordance with the Instructions for Continued Airworthiness **ICA-D130-701**.

3. INSTALLATION PROCEDURE

1. In order to install the D130-701-041 ***Heli-Utility-Basket™***, the aircraft must first be fitted with the 350A21-1068-03 and 350A21-1069-03 Cargo Swing Support Brackets per the Aircraft Maintenance Manual.
2. To facilitate the installation of the D130-701-041 basket, remove the steps that are attached to the landing gear on the side(s) of the aircraft that the basket is being installed.
3. Install the D3173-041 Beams on the 350A21-1068-03 and 350A21-1069-03 Cargo Swing Support Brackets as shown in Figure 2 using the AN5 hardware indicated (or optionally with a positive locking 5/16" stainless steel quick release pin with a minimum double shear strength of 6000 lbs and a minimum grip length of 0.60", such as a BLRS-051 / BLBS-051 or MS17984C506 / MS17985C506 / MS17986C506 / MS17987C506). Note that if baskets are being installed on both sides of the aircraft, one set of D3173-041 Beams is redundant and do not need to be installed. To assist in the installation, the AN3-5A bolts that attach the D3175-041 Mounting Lug to the D3173-041 Beams are loosely attached and must be tightened after locating the beam.
4. Install the D3177-041 Bracket on the fwd basket attachment lugs and the D3177-043 Bracket on the aft basket attachment lugs as shown in Figures 3 & 4.
5. Slide the basket complete with D3177-041/-043 Brackets into the D3173-041 Beams that are already on the aircraft as shown in Figures 3 & 4. The D3177-041/-043 Brackets should contact the AN5 bolts in the D3173-041 Beams and then should be secured in place with AN5 hardware shown (or optionally with a positive locking 5/16" stainless steel quick release pin with a minimum double shear strength of 6000 lbs and a minimum grip length of 2.00", such as a BLRS-053 / BLBS-053 or MS17984C520 / MS17985C520 / MS17986C520 / MS17987C520).
6. Install D3180-041 Strut Assembly as shown in Figure 5.
7. Repeat steps 4 & 5 if a basket is being installed on the other side of the aircraft.
8. It is optional to re-install landing gear steps as required per the Aircraft Maintenance Manual.
9. Update aircraft Weight and Balance data in accordance with Section 4 of this document. If the landing gear steps are removed, the aircraft Weight and Balance must be adjusted accordingly.

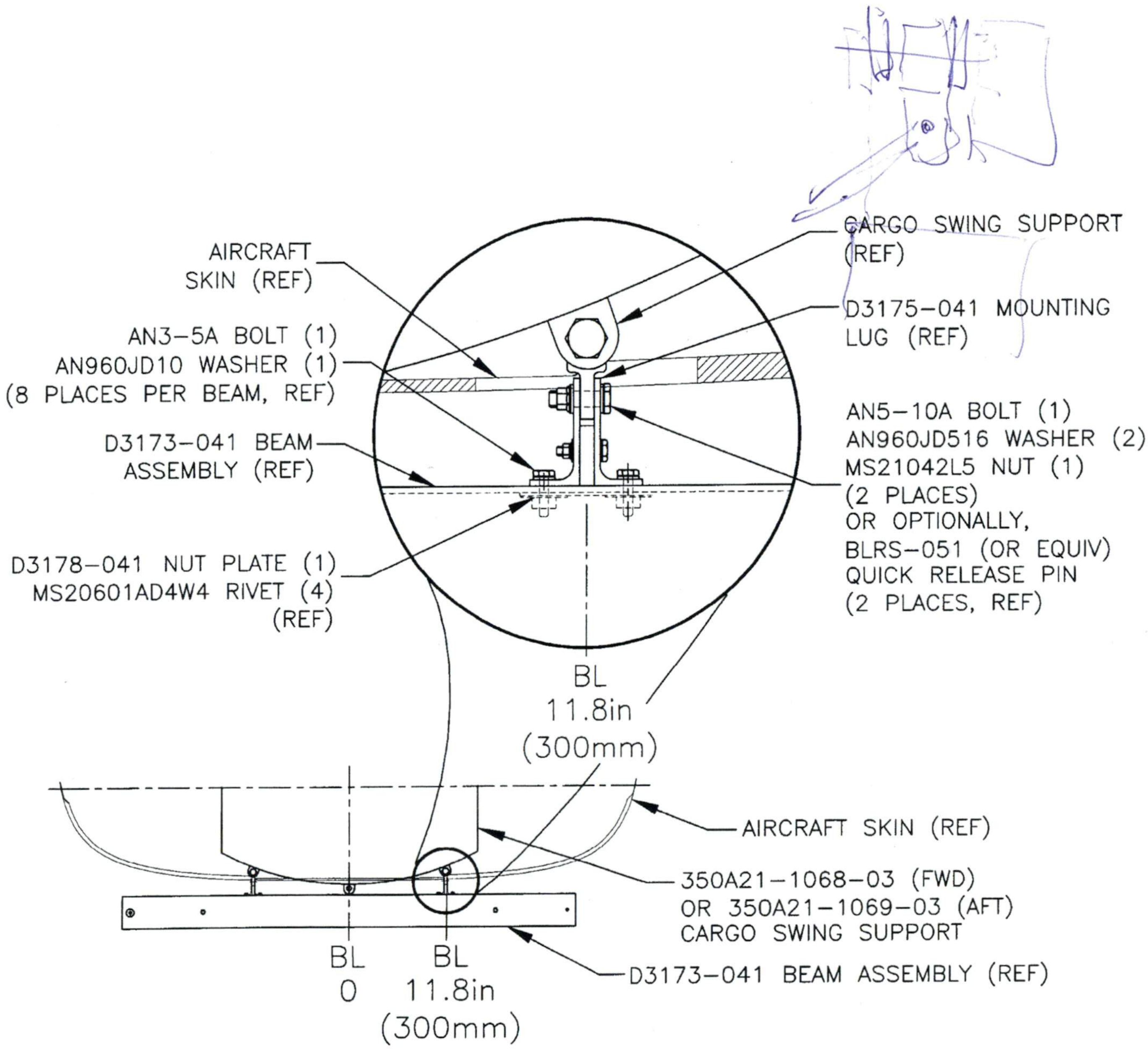


Figure 2 – Typical D3173-041 Beam Installation

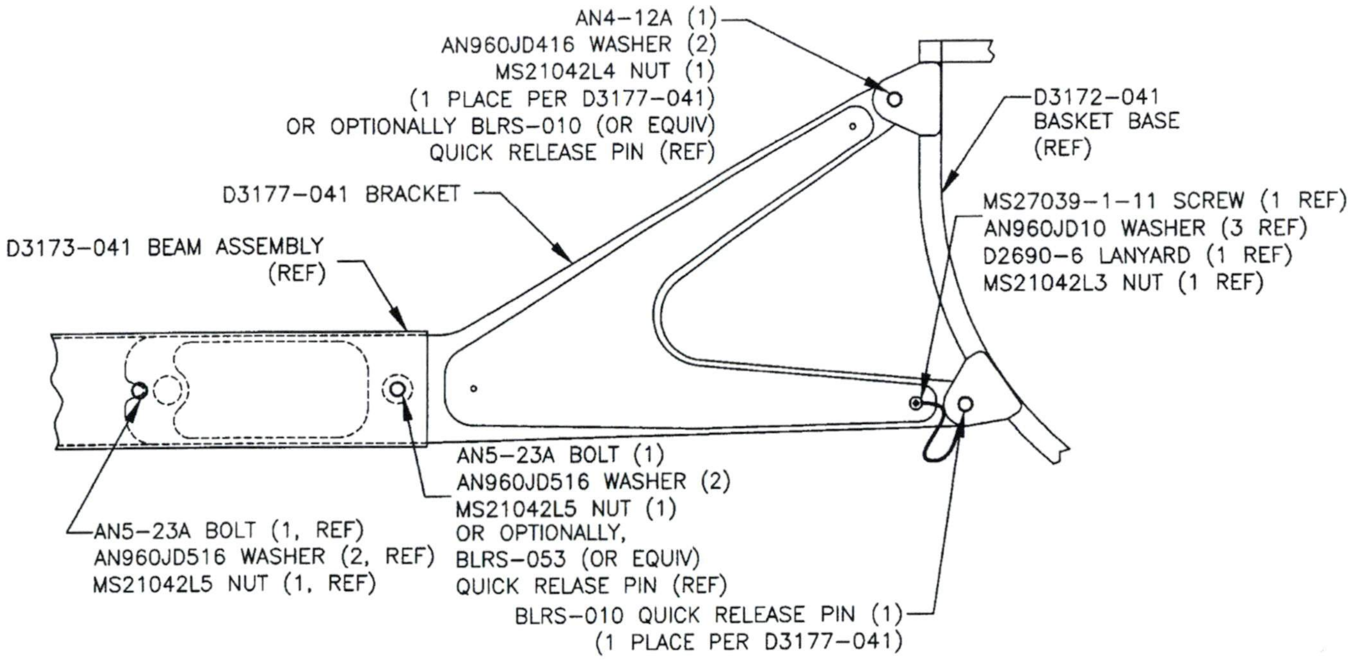


Figure 3 – Fwd Bracket Attachment

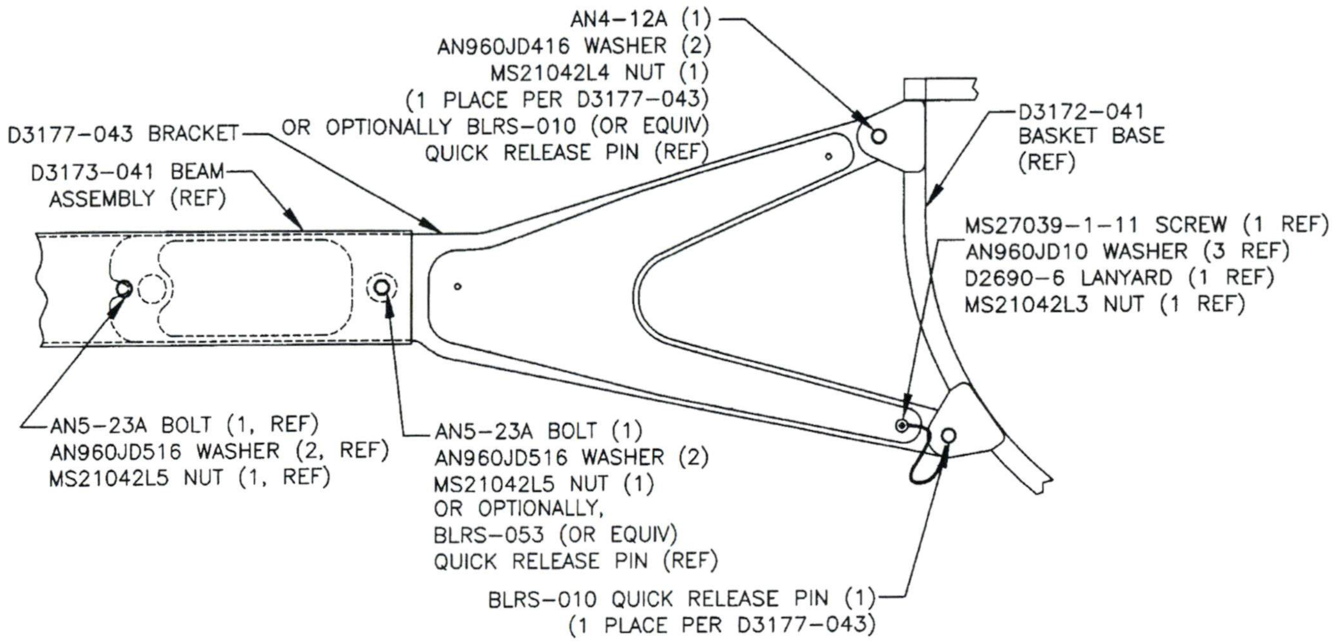


Figure 4 – Aft Bracket Attachment

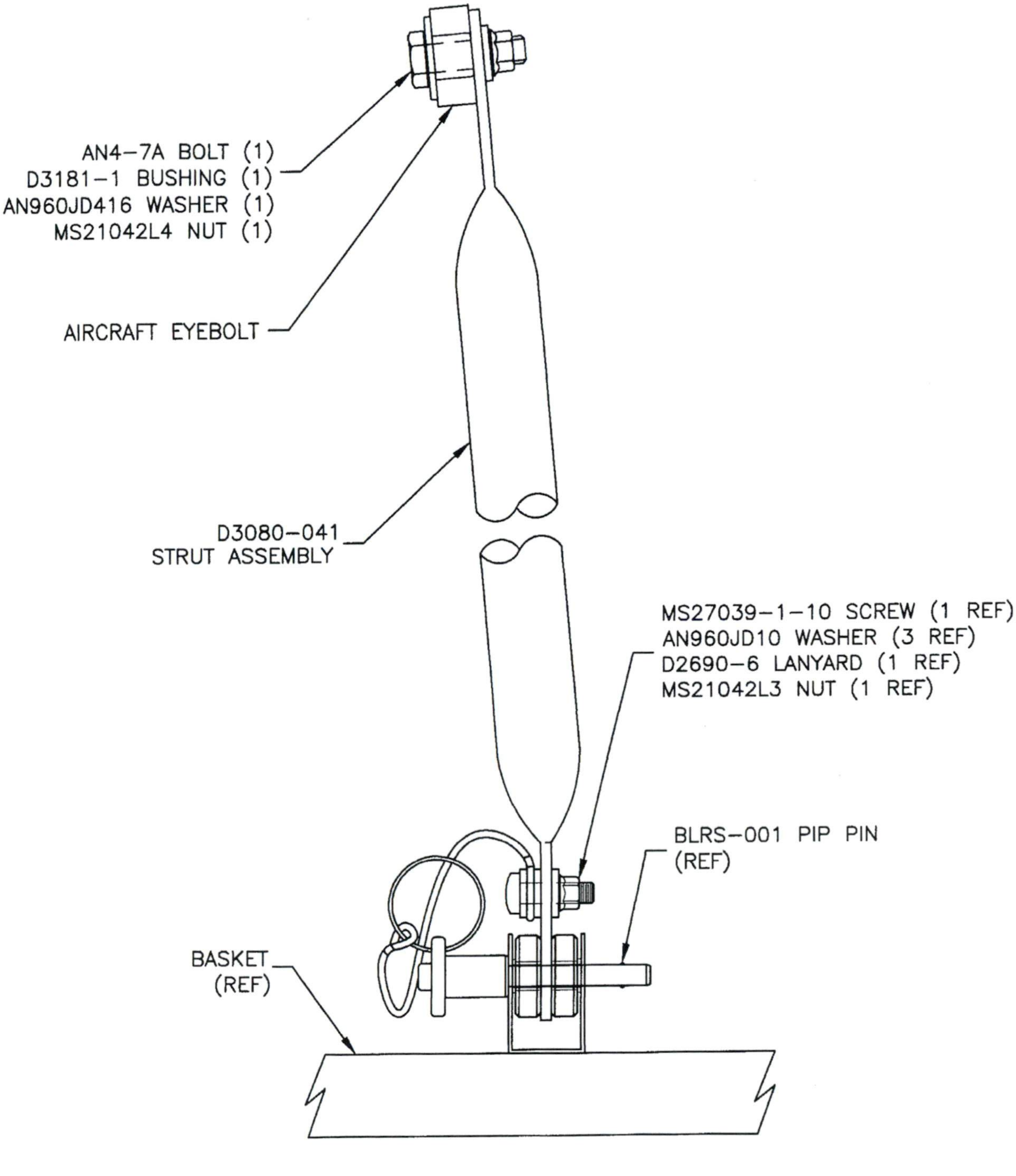
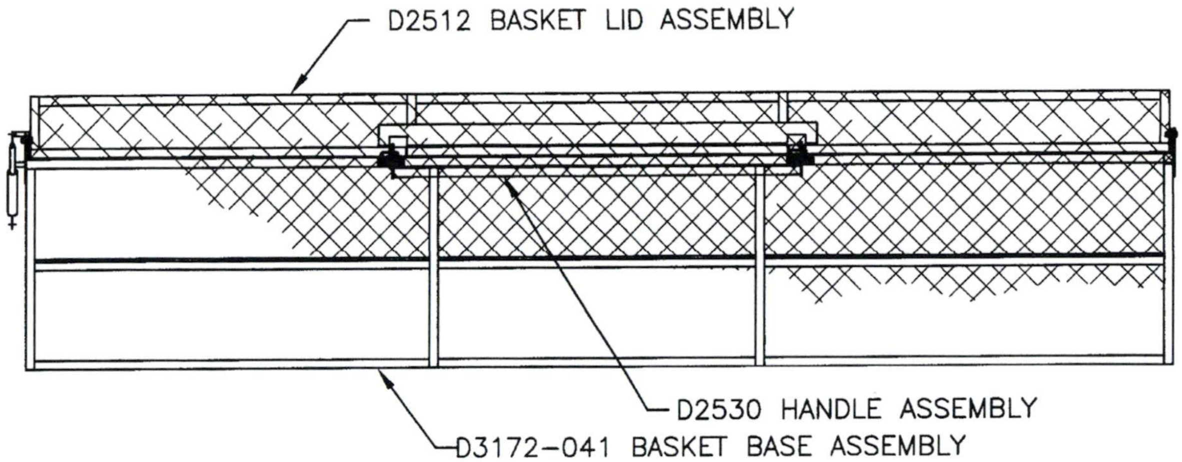
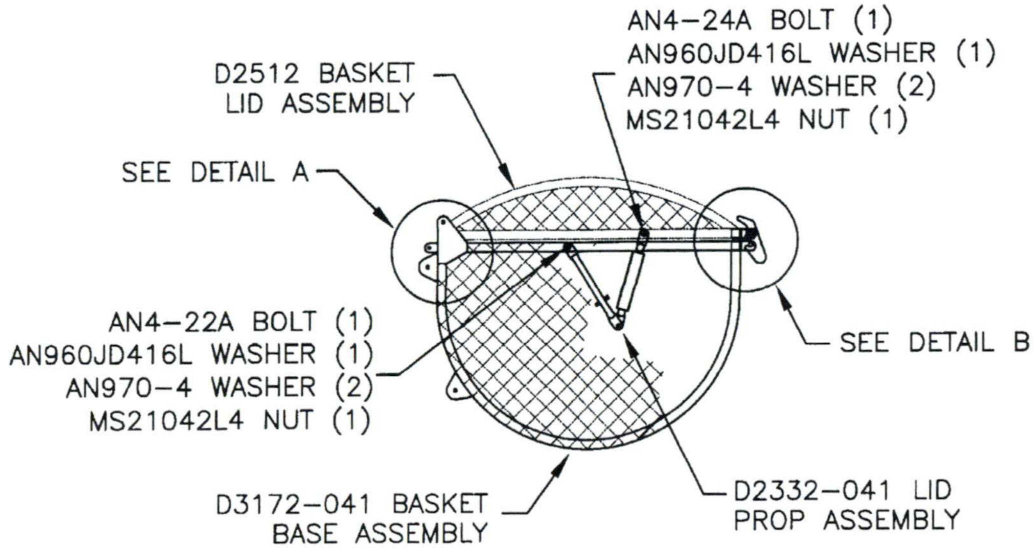


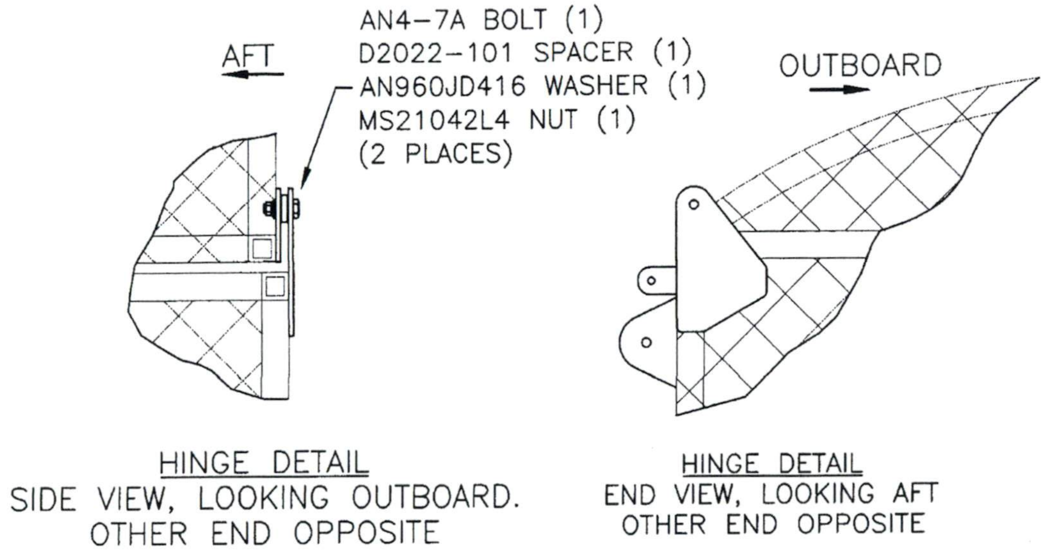
Figure 5 – Strut
(From Figure 1)



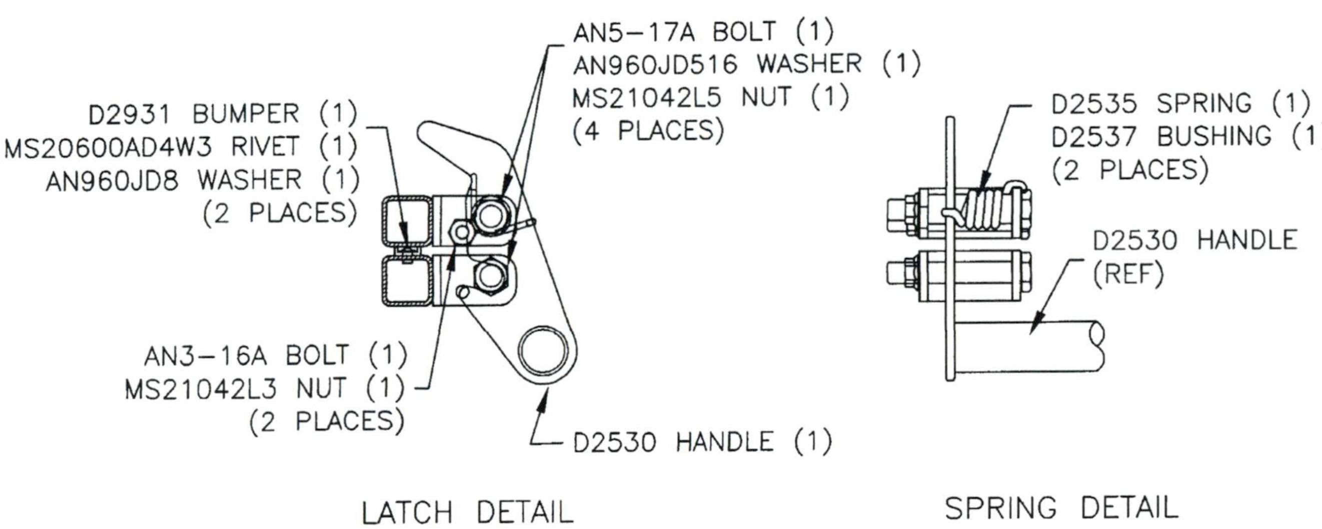


PROP ARM DETAIL

Figure 6 – Basket Replacement Parts



DETAIL A



DETAIL B

Figure 7 – Basket Replacement Parts continued

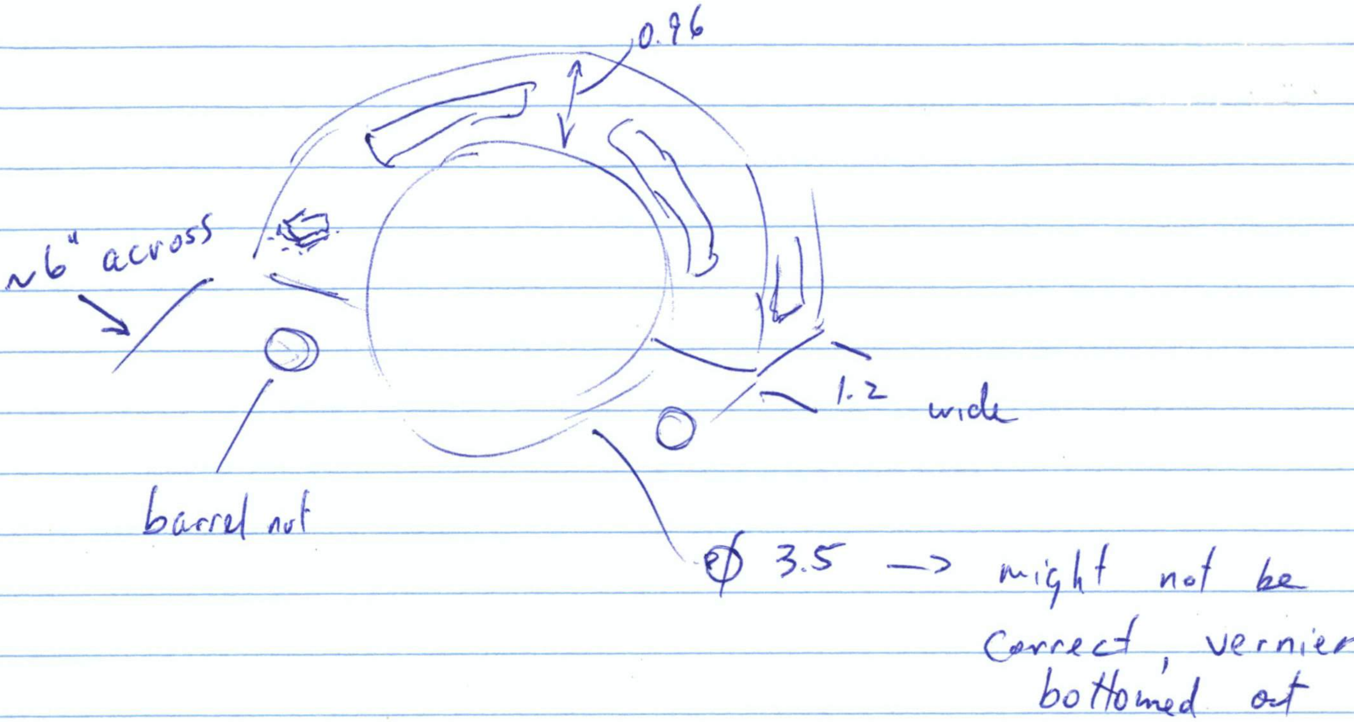
4. WEIGHT AND BALANCE

Installation	Weight	LATERAL		LONGITUDINAL	
		Arm	Moment	Arm	Moment
D130-701-041 (LH installation)	120 lb 54 kg	- 47.4 in - 1.20 m	- 5688 in-lb - 64.8 m-kg	133.9 in 3.40 m	16068 in-lb 183.6 m-kg
D130-701-041 (RH installation)	120 lb 54 kg	+ 47.4 in + 1.20 m	+ 5688 in-lb + 64.8 m-kg	133.9 in 3.40 m	16068 in-lb 183.6 m-kg
2 x D130-701-041 (LH & RH installation)	224 lb 102 kg	0.0 in 0.00 m	0 in- lb 0.0 m-kg	133.9 in 3.40 m	29994 m-kg 346.8 m-kg

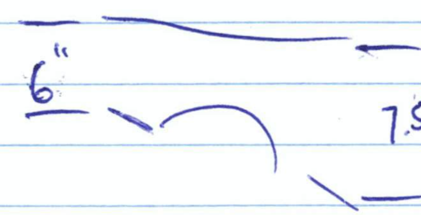
5. PARTS LIST

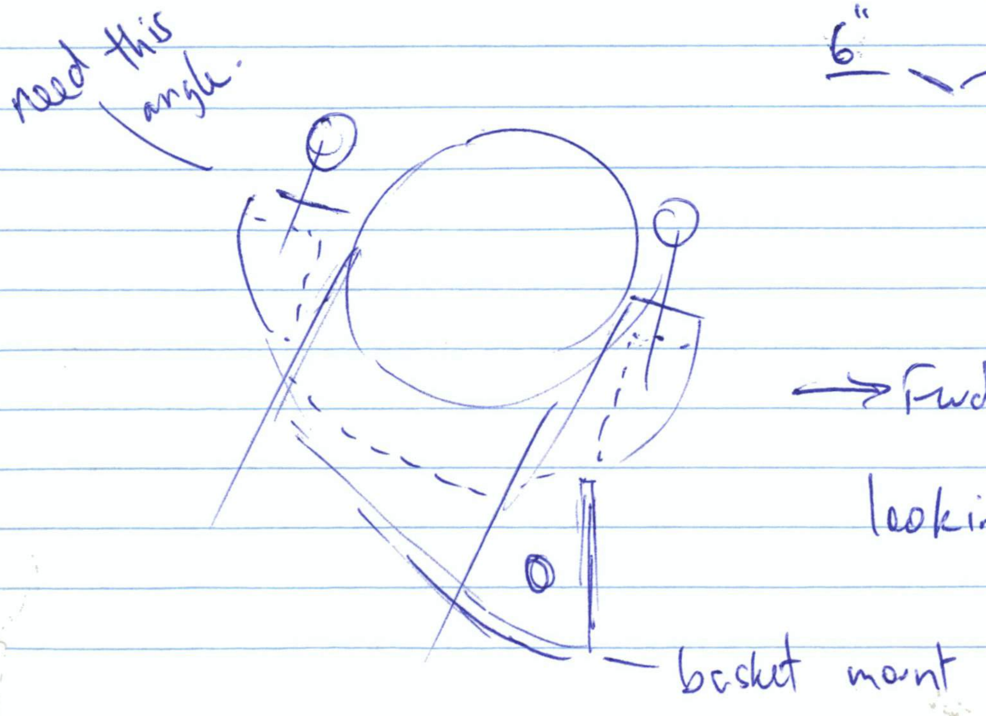
Qty -041	Part Number	Description
X	**D130-701-041**	**HELI-UTILITY-BASKET**
2	D2022-101	SPACER
1	D2258-220	LABEL
1	D2332-041	PROP ASSEMBLY
1	D2512	BASKET LID ASSEMBLY
1	D2530	HANDLE ASSEMBLY
2	D2535	SPRING
2	D2537	BUSHING
2	D2931	BUMPER
1	D3172-041	BASKET BASE ASSEMBLY
2	D3173-041	BEAM ASSEMBLY
1	D3177-041	BRACKET ASSEMBLY
1	D3177-043	BRACKET ASSEMBLY
1	D3180-041	STRUT ASSEMBLY
1	D3181-1	BUSHING
2	AN3-16A	BOLT
2	AN4-12A	BOLT
1	AN4-22A	BOLT
1	AN4-24A	BOLT
3	AN4-7A	BOLT
4	AN5-10A	BOLT
4	AN5-17A	BOLT
2	AN5-23A	BOLT
7	AN960JD416	WASHER
2	AN960JD416L	WASHER
16	AN960JD516	WASHER
2	AN960JD8	WASHER
4	AN970-4	WASHER
2	MS20600AD4W3	RIVET
2	MS21042L3	NUT (OR MS21042-3)
7	MS21042L4	NUT (OR MS21042-4)
10	MS21042L5	NUT (OR MS21042-5)

49" spacing as is

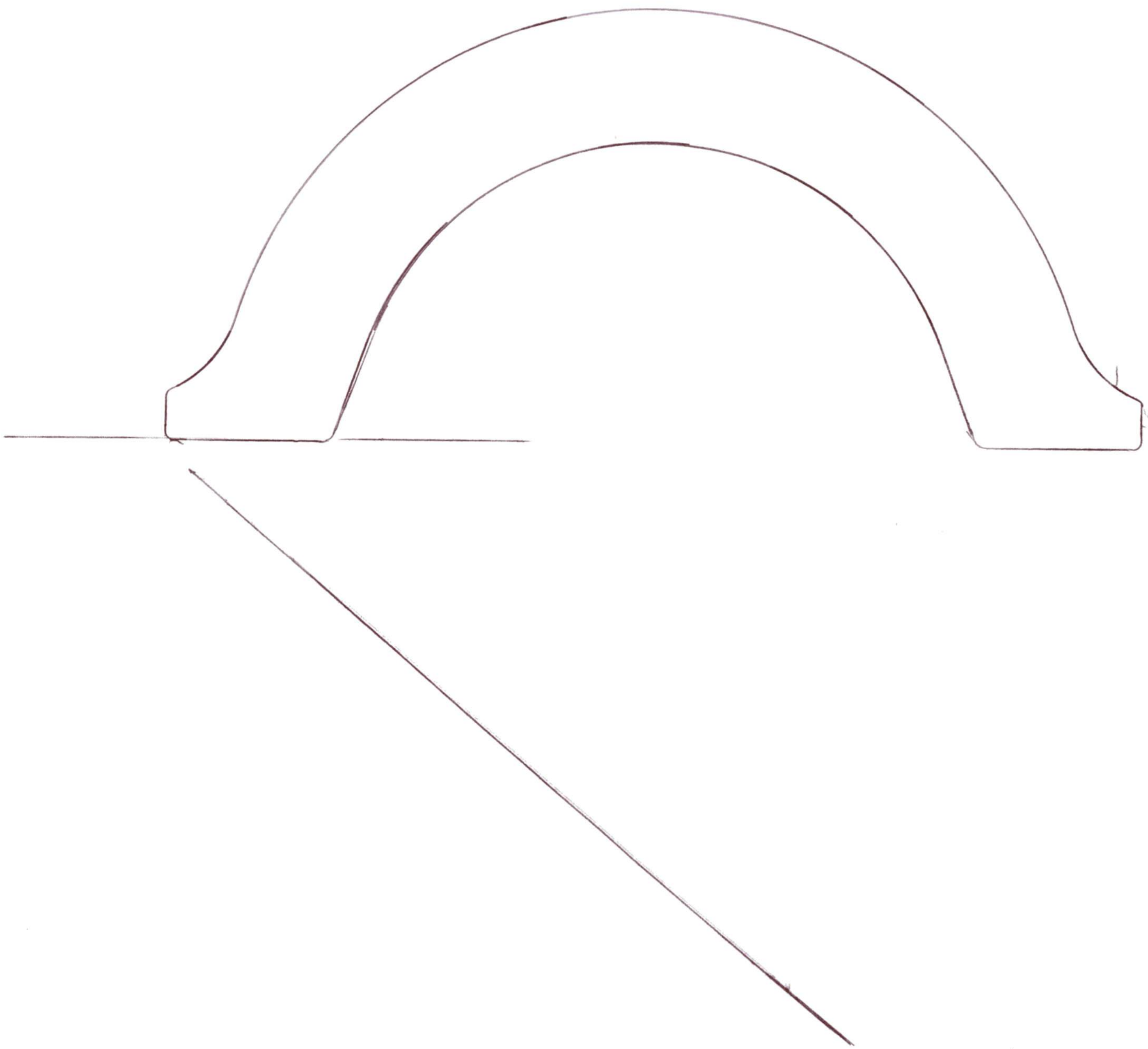


Fwd side may be better choice, open in cowling





Pen width increases slightly, more on outside edge since inside is chamfered



fwd → DOESN'T BLOCK USE OF CARGO SWING?

ONLY IF SUPPORTS GO FWD.

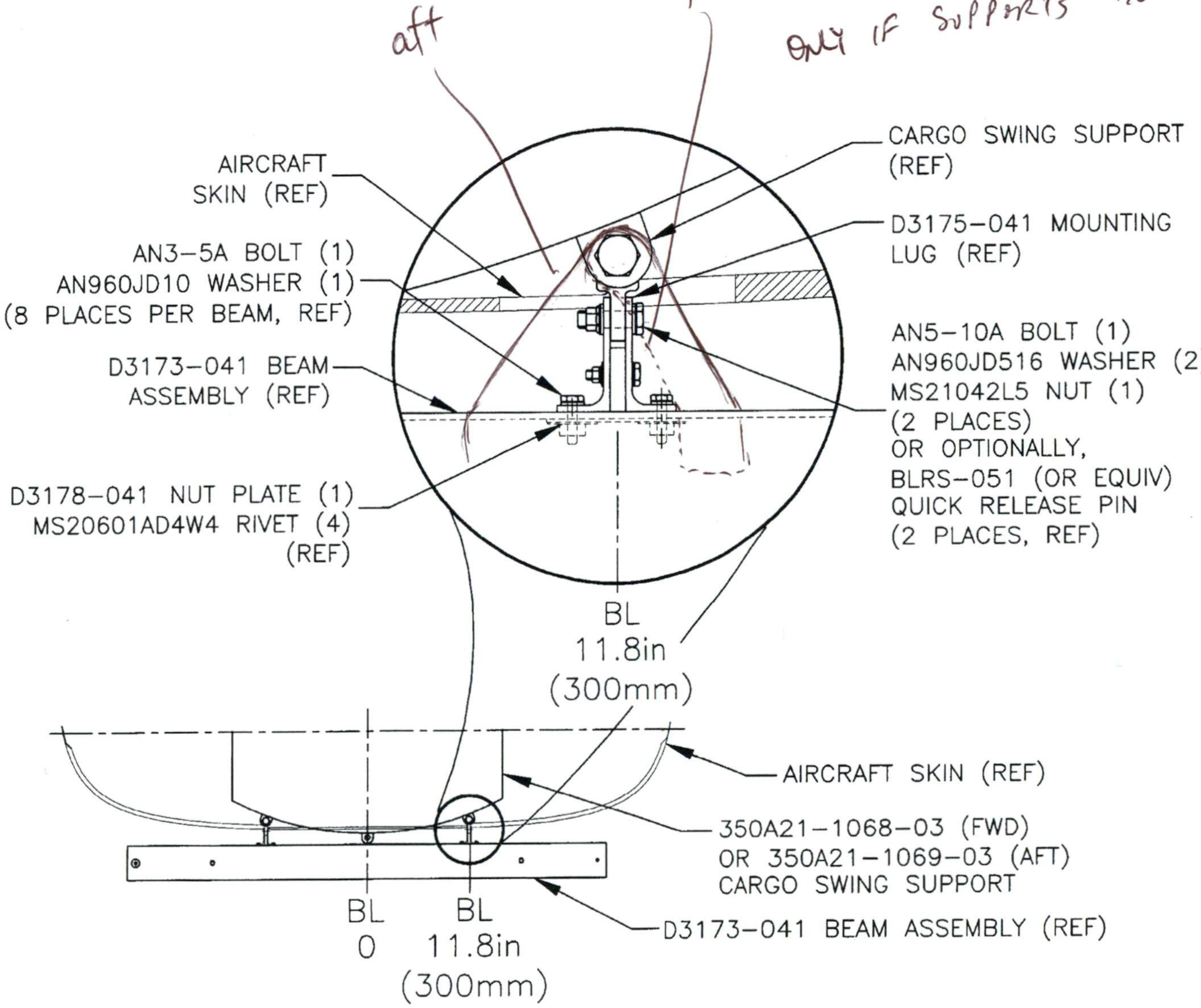
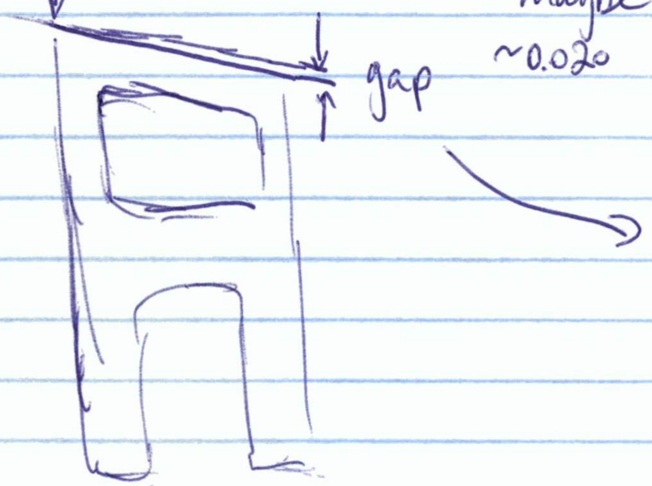


Figure 2 – Typical D3173-041 Beam Installation

Aft fittings

This ftg is a prob for installing the cowling

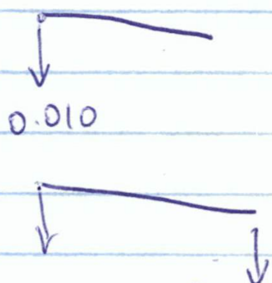
fraction too high



gap

Maybe ~0.020

bring point down



0.010

bring whole edge down

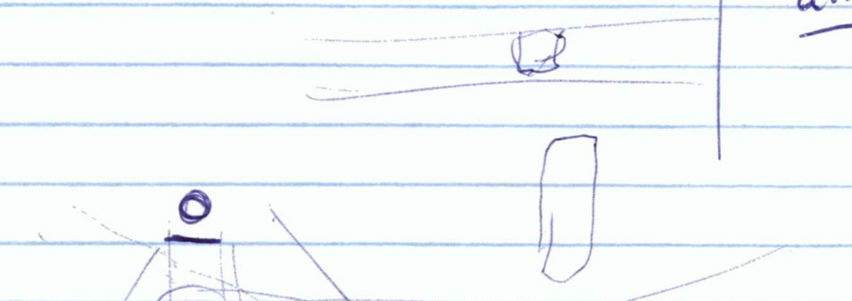
0.010

Fairing → ← 0.06 ~0.08

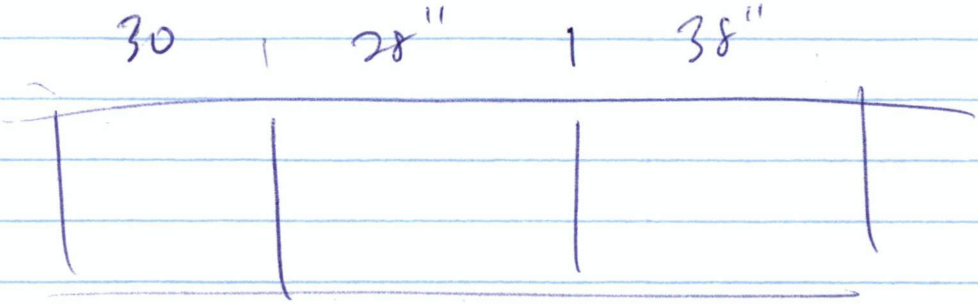
Interferes.

Forward Good.

Standard config
sliding door left
big door / sm door right
all A/C.

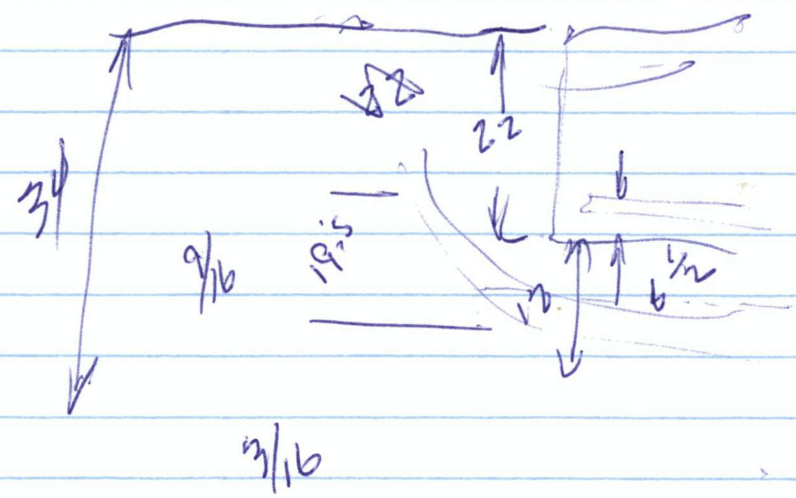


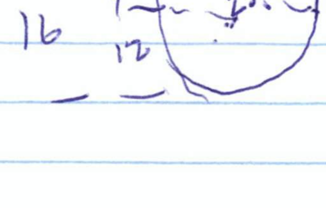
DART

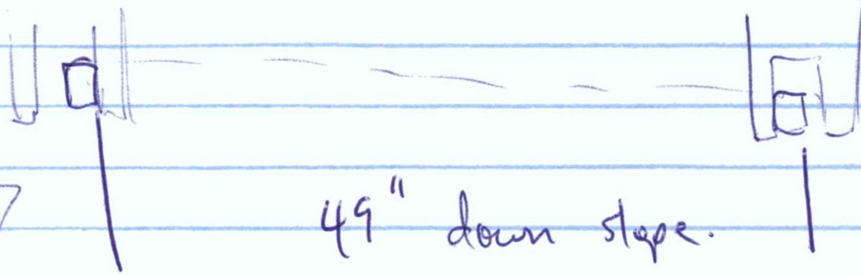


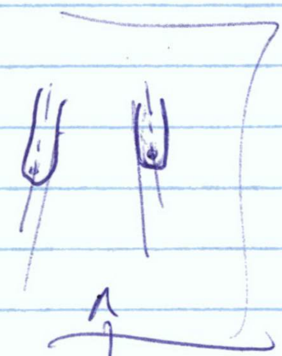
DART → FWD

Approx









49" down slope.

~49-1/16 opposite

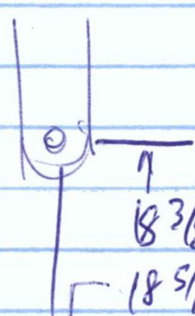
c-c

Can't check this

31 9/16 + 1/64 aft

31 15/16 fwd

* fittings not centred on beam.



18 3/8 fwd

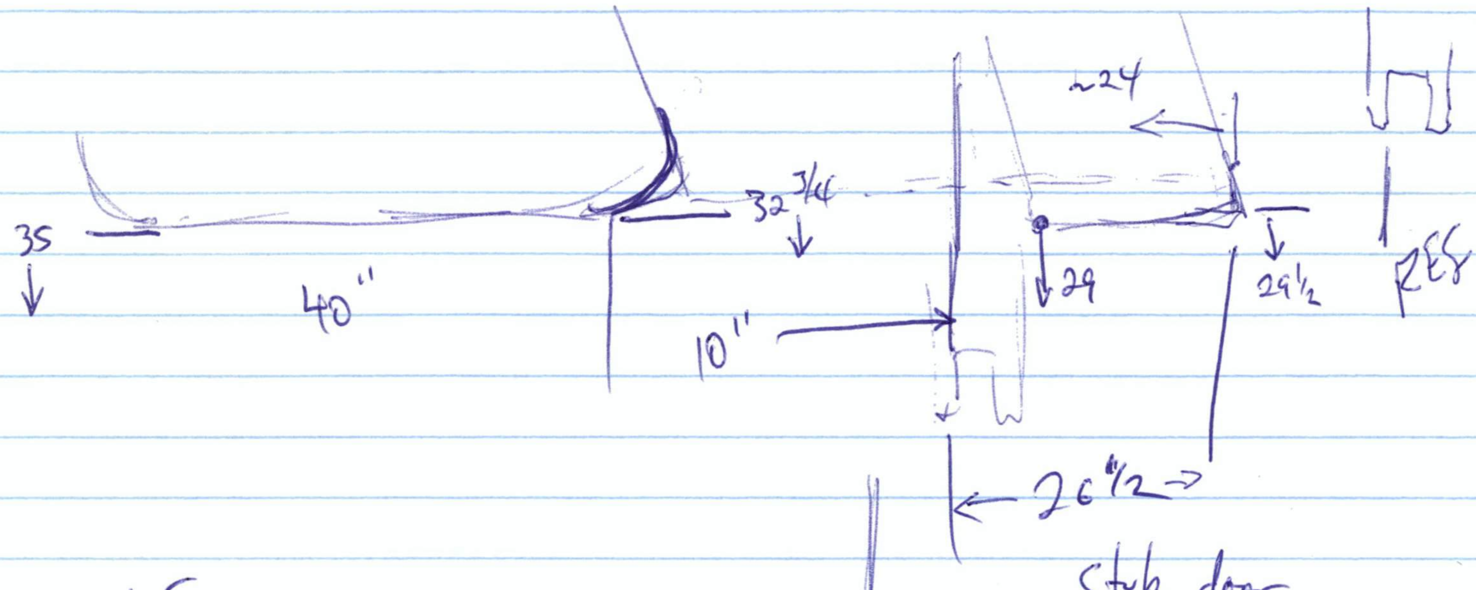
18 5/16 fwd

27 aft

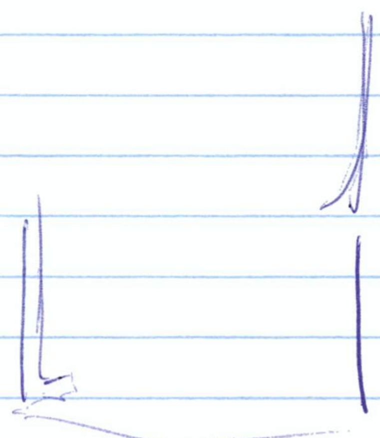
26 5/8

pivoting gear

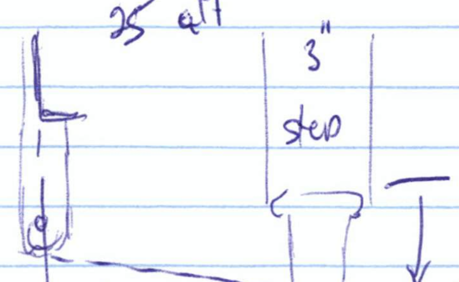
Top of basket - no more than 32 1/4 from ground



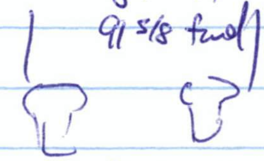
RHS



27 fwd
25 aft



87 aft
91 5/8 fwd



fwd @ 53" fwd
~~aft~~ @
~~102~~ between fwd/aft

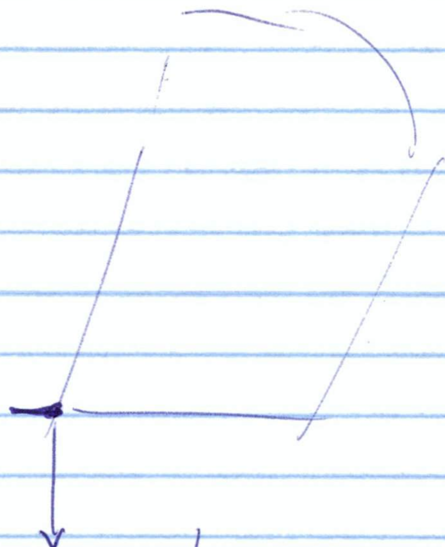
~~Aftd~~

22 5/8 @ aft
19 @ fwd

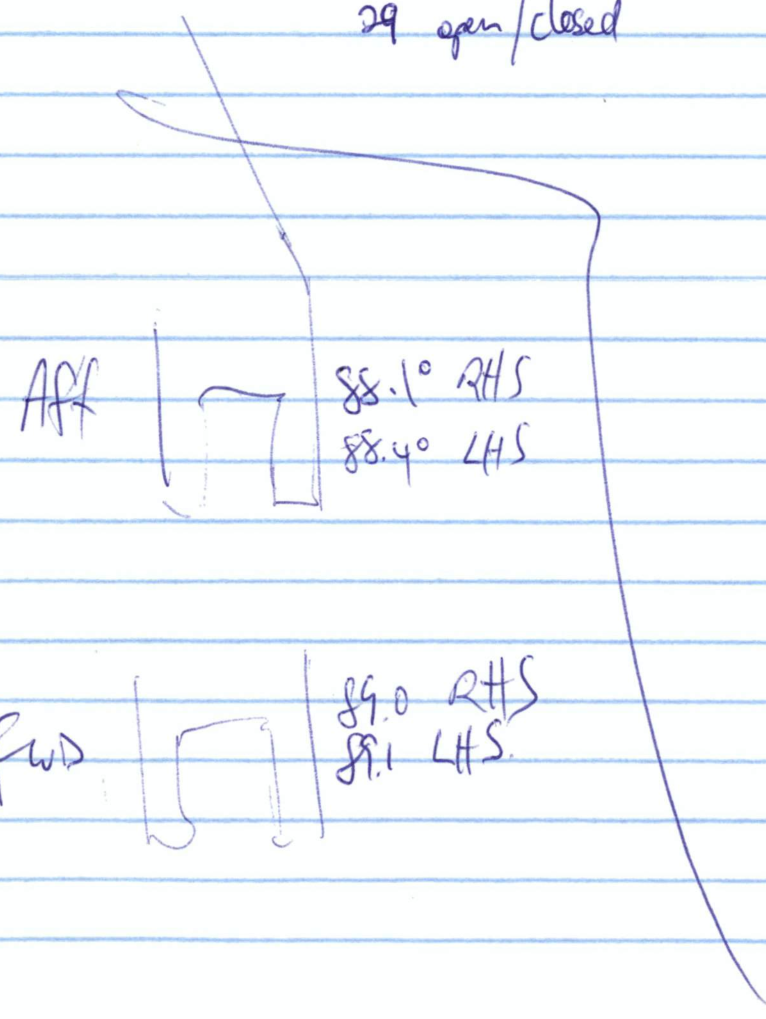
Aluminum Parts → Anodize → no paint

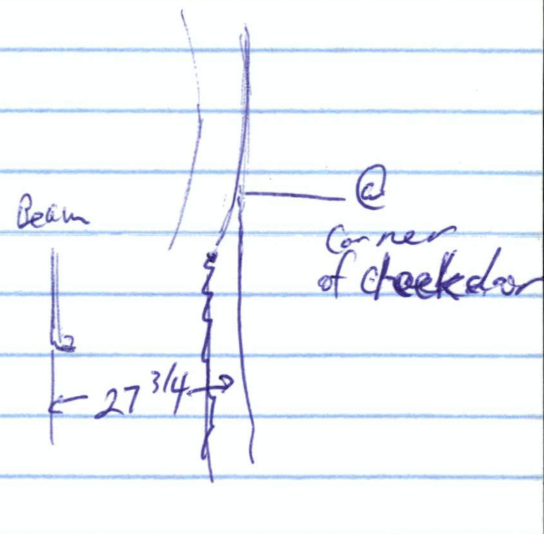
Stainless → bare

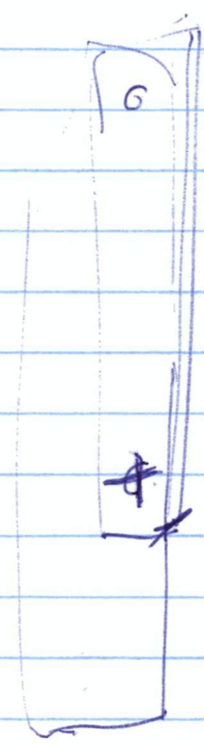
LHS

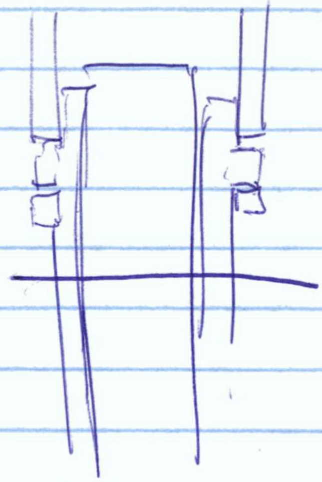


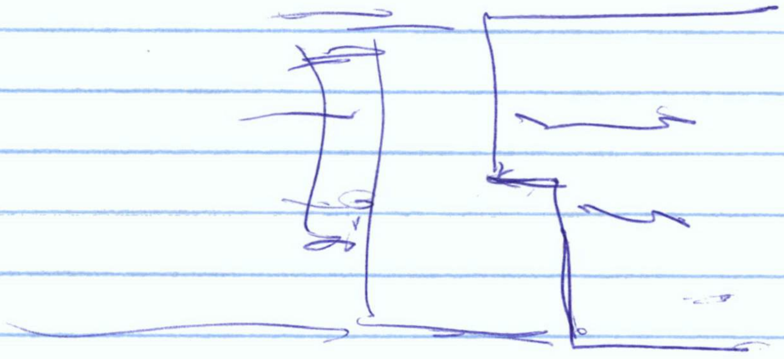
29 open/closed

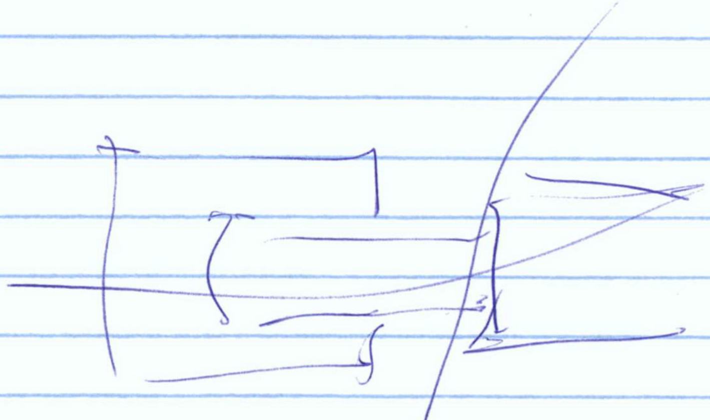




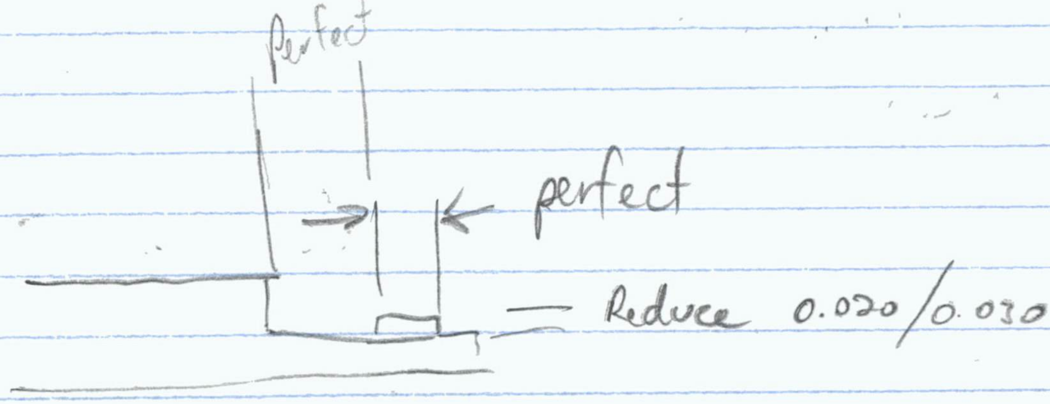

6
4

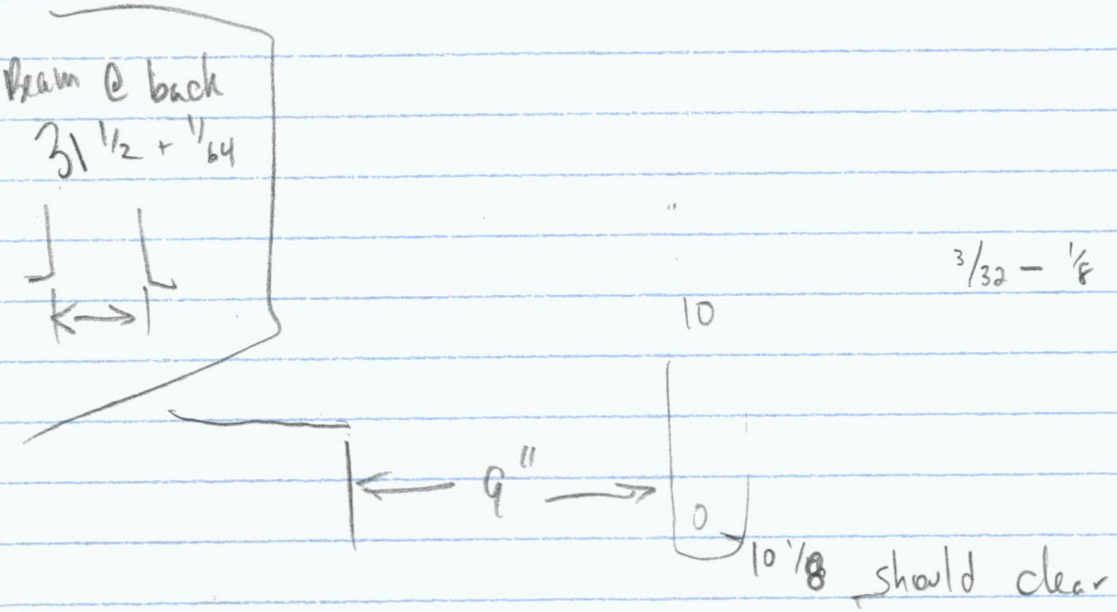




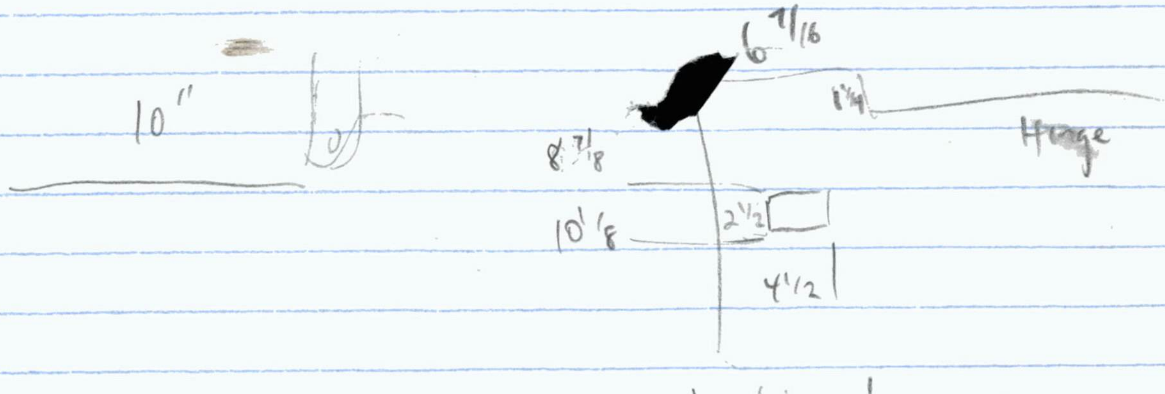


Front

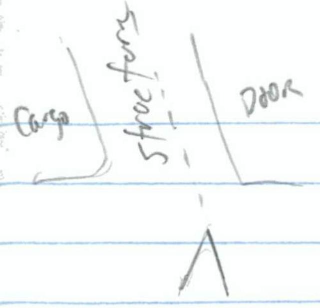




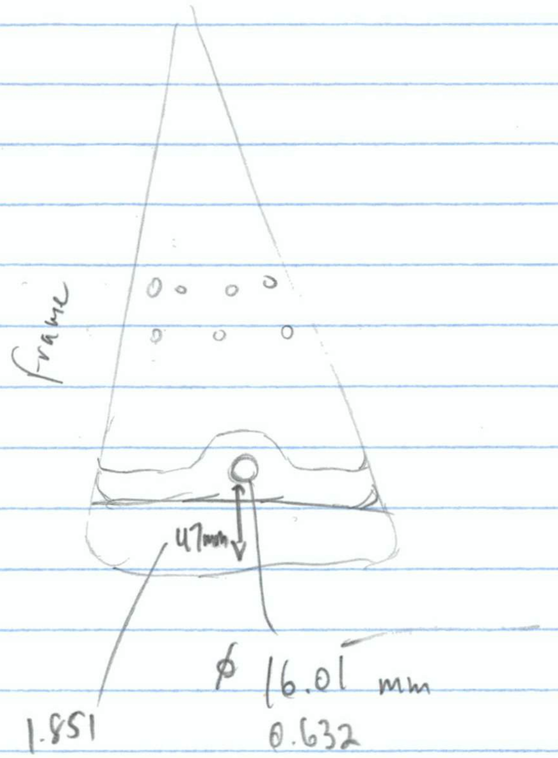
3/32 – 1/8 clearance req.



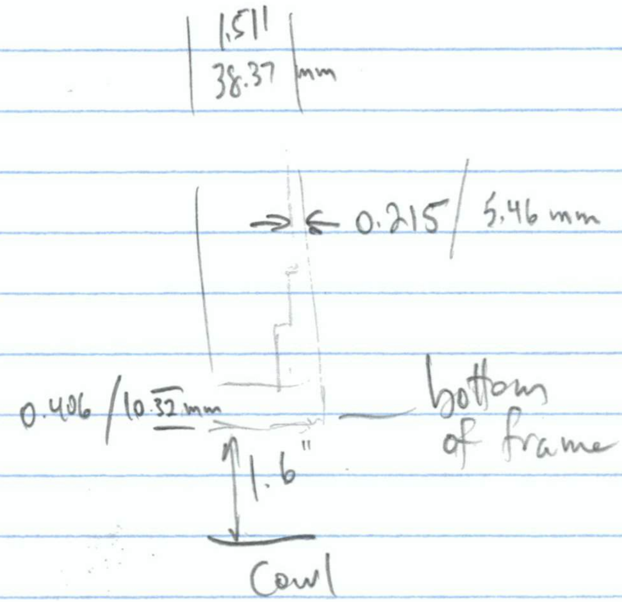
Looking down @
RH panel



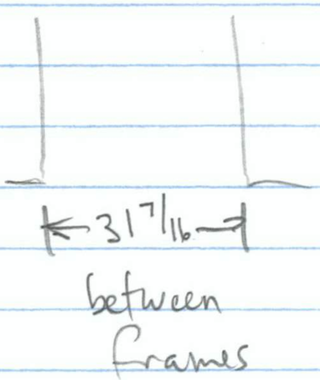
Cargo
structure
DOOR



frame
47mm
ϕ 16.01 mm
0.632
1.851

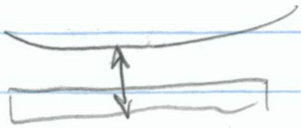


1.511
38.37 mm
0.215 / 5.46 mm
0.406 / 10.32 mm
bottom of frame
1.6"
Cowl



31 7/16
between frames

Custom Carbon ASAP



CL of lugs

board 3.469

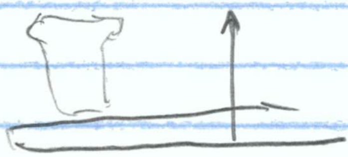
CL	1.344	
2"	1.375	
4"	1.438	
6"	1.655	
8"	1.791	
(9.75) 10	2.065	front clear hole.
12	(hole)	
14	2.915	
16	3.632	
18	4.265	
20	5.118	
22	8.313	(square measured)

aft side

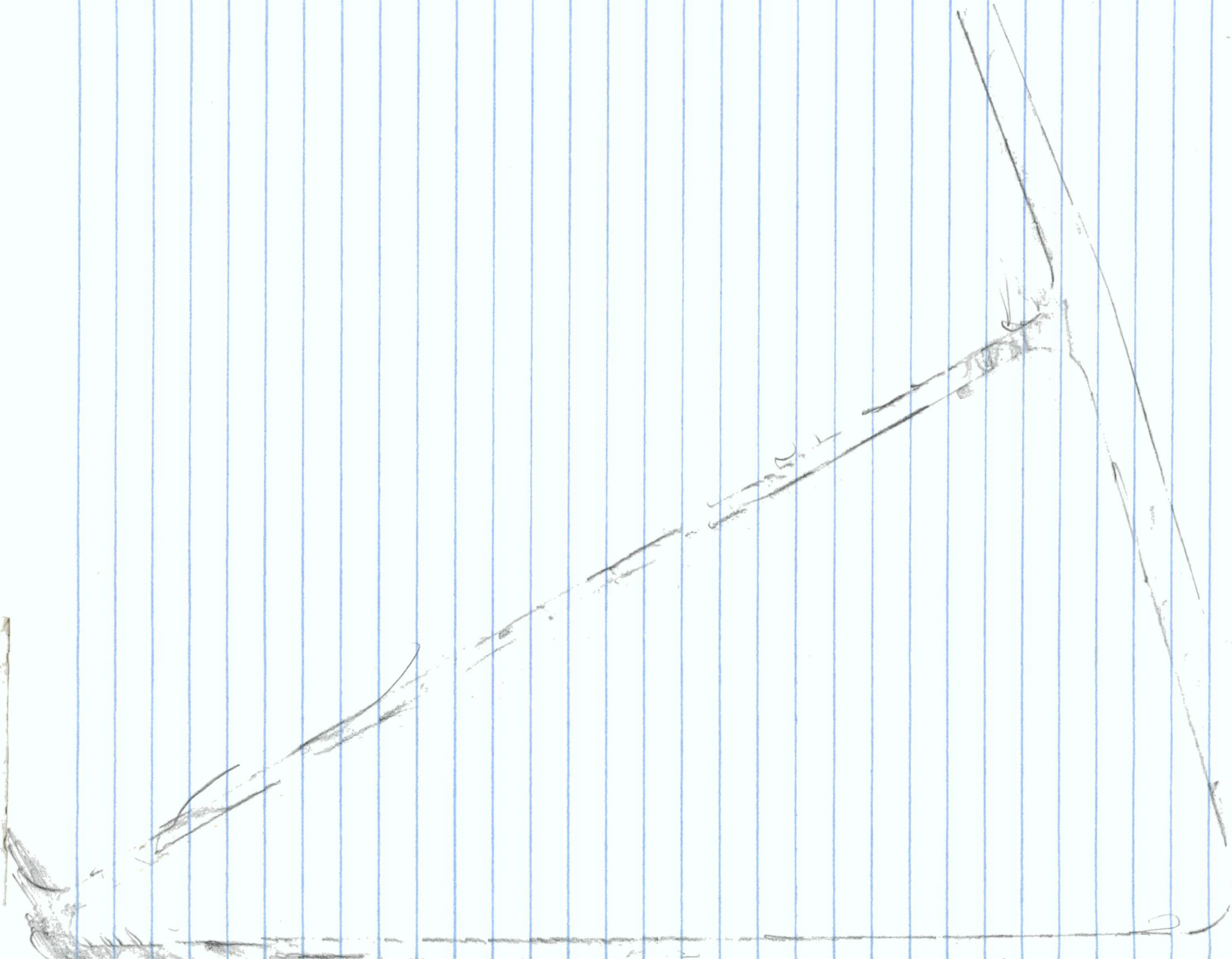
CL	2.00	
2	2.114	
4	2.230	
6	2.388	
8	2.619	
10	2.947	
12	3.360	
14	3.961	
16	4.630	
18	5.266	(slight slope from fairing
20		
22		

Fwd Profile

Back edge
℄ of hole



℄	2.732	
2	2.739	
4	2.745	
6	2.761	
8	2.619 ?	middle panel raised
10	2.610	
12	2.615	
14	2.653	
16	2.684	
18	2.728	
20	2.817	
22	2.953	
24	3.142	
26	3.358	
28	3.748	
30	4.220	
32	4.988	
34	5.735	
36	8.00	
38		
40		

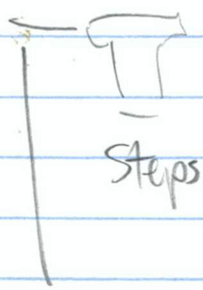


Bottom of pod 35 (Squirrel Cheek)

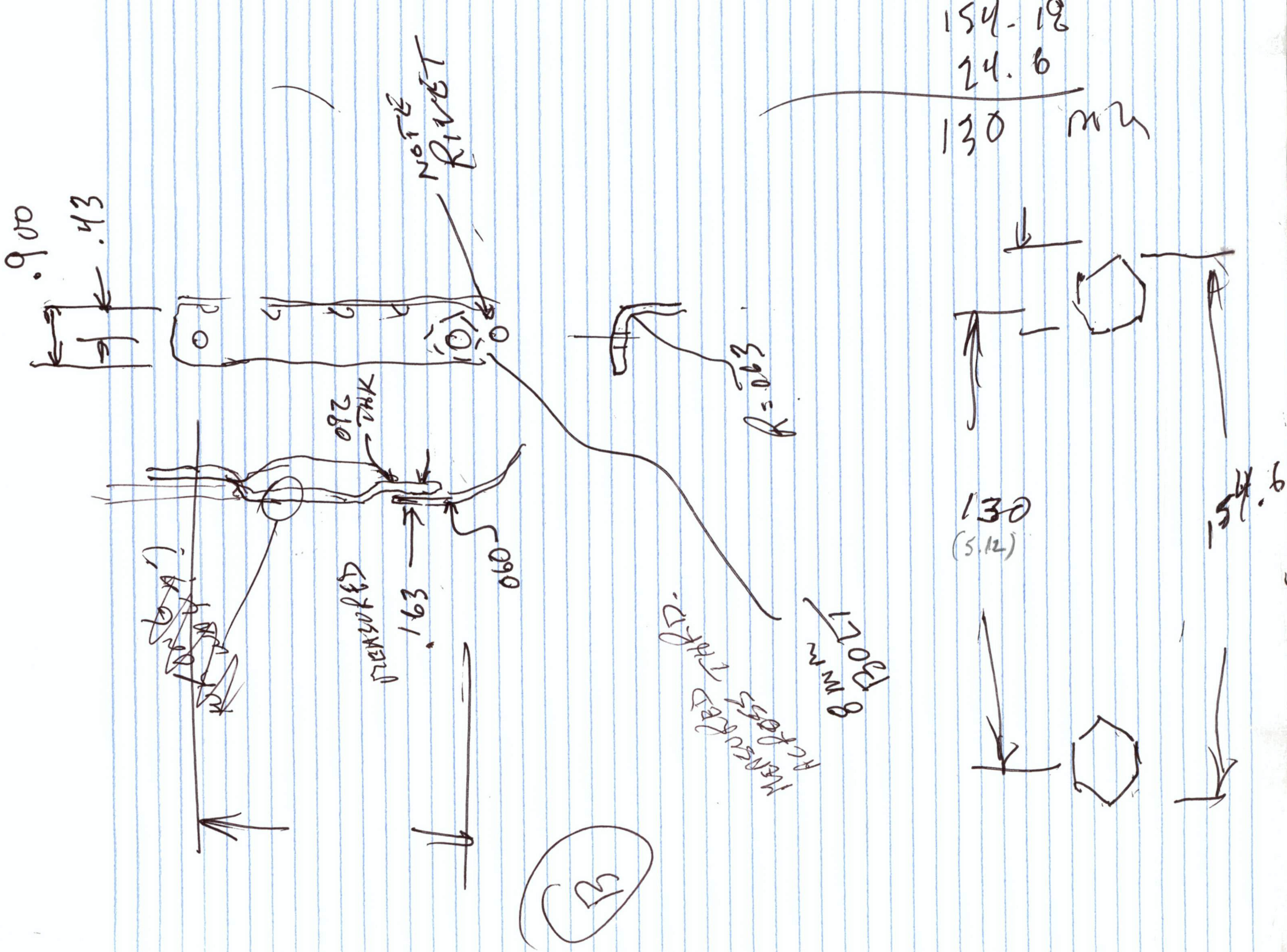
to cowling @ 25 1/2
aft swing attach

92 fwd
87 3/8 aft

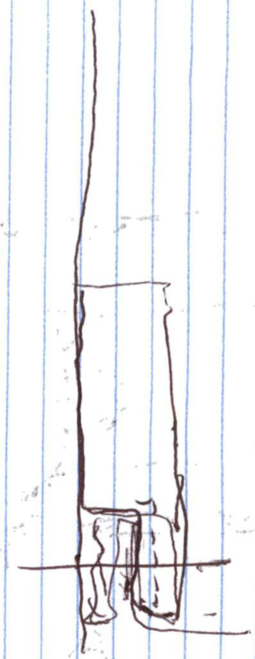
@ fwd edge of
fairing



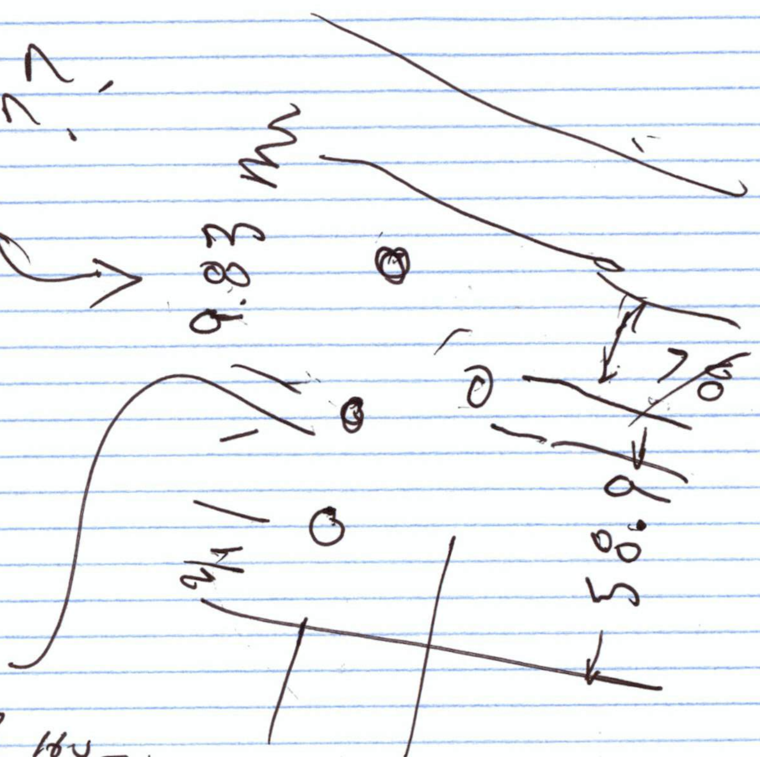
18 1/4 fwd
22 1/4 aft
w/ bearpaw

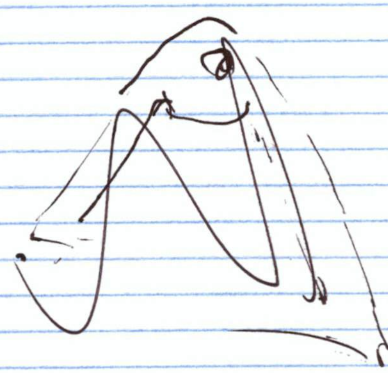


154.18
24.6
130 mm
.900
.43
NOTE RIVET
R=.063
.210 THK
.060
.163
MEASURED
8MM BOLT
130
(5.12)
154.6
B



HOLE DIAMETER ??





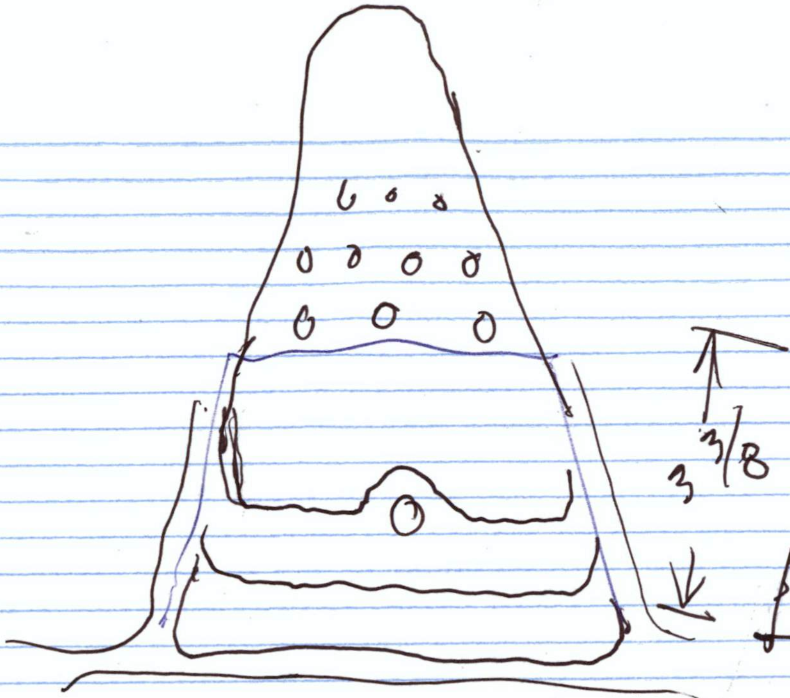
3 HUCK BOLTS 1 1/8"

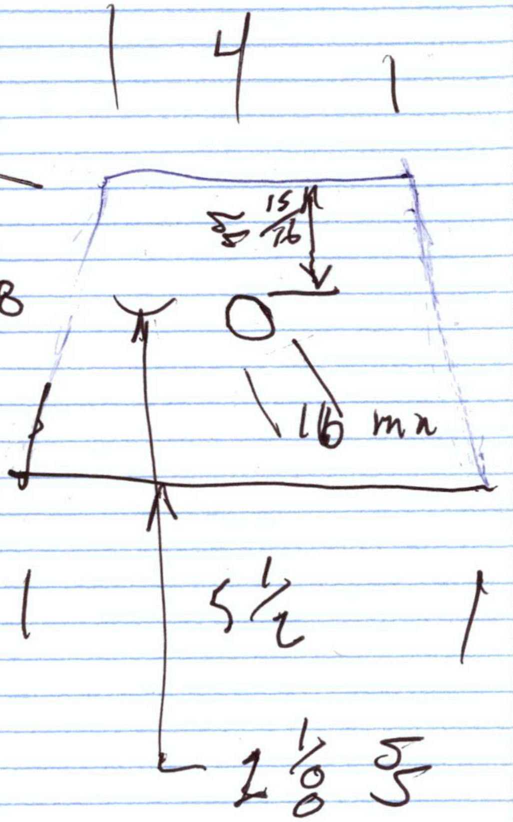
6 mm HIGH

6,5

0.212" mm

0.387
254) 98.3
76 2
22 10
20 32
1 780
1 778



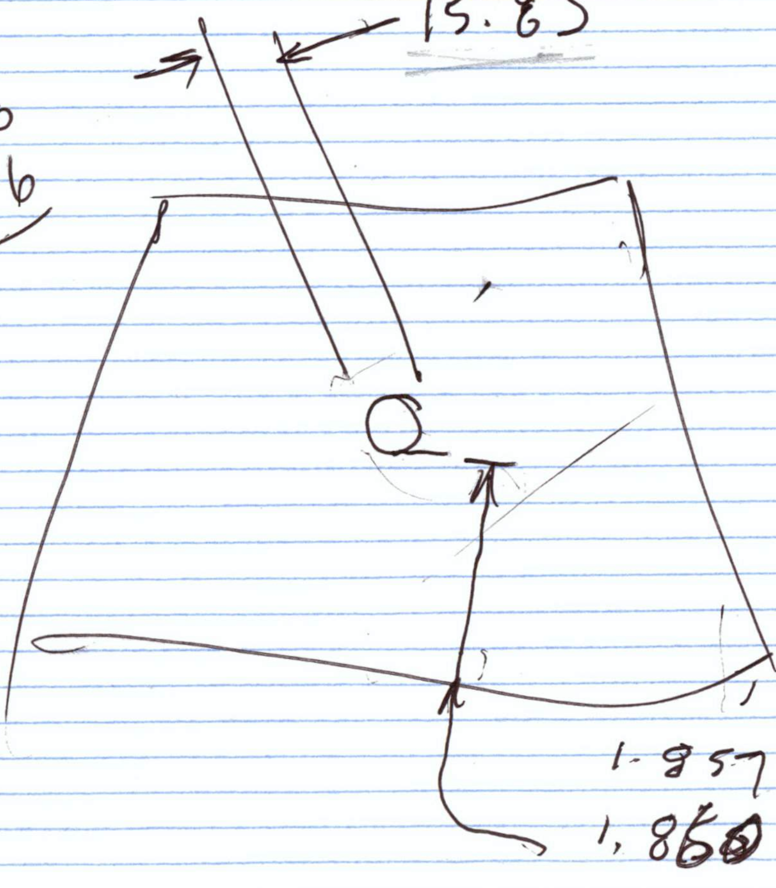


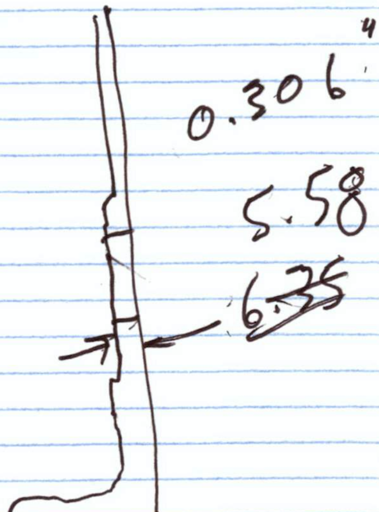
5/8

.624

254 | 158.5
15 2 4
6 10
5 08
1020
1016

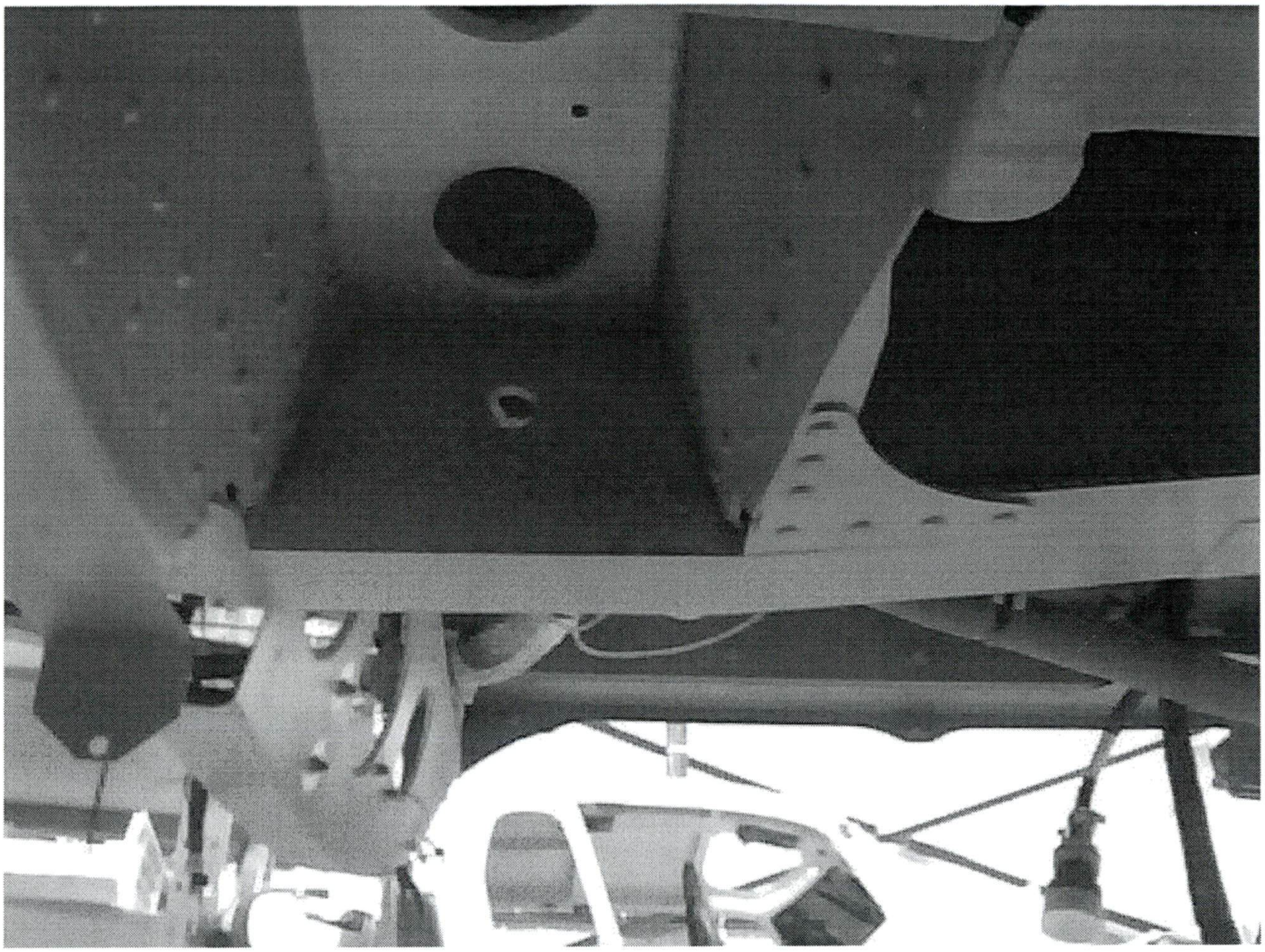
.617"





1.857
1,860
47.33

FWD



You've received a Message from a TELUS phone.

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BACKSIDE OF 1

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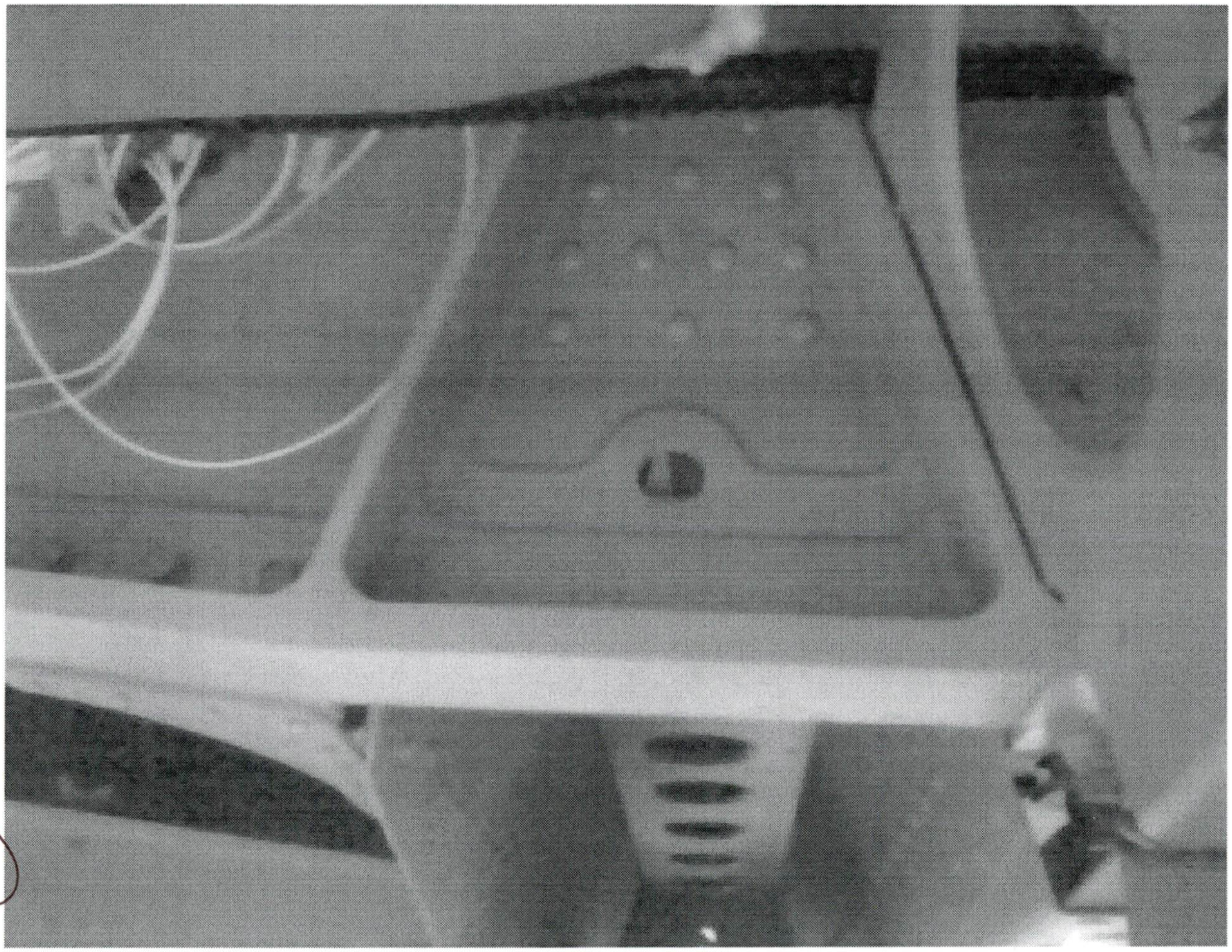
Si vous ne voyez ni n'entendez le fichier, veuillez télécharger QuickTime.

TELUS

Jeff Clarke

From: 4038526424 [4038526424@msg.telus.com] on behalf of 4038526424@msg.telus.com
Sent: July 29, 2010 11:17 AM
To: jeff@aerodesign.ca

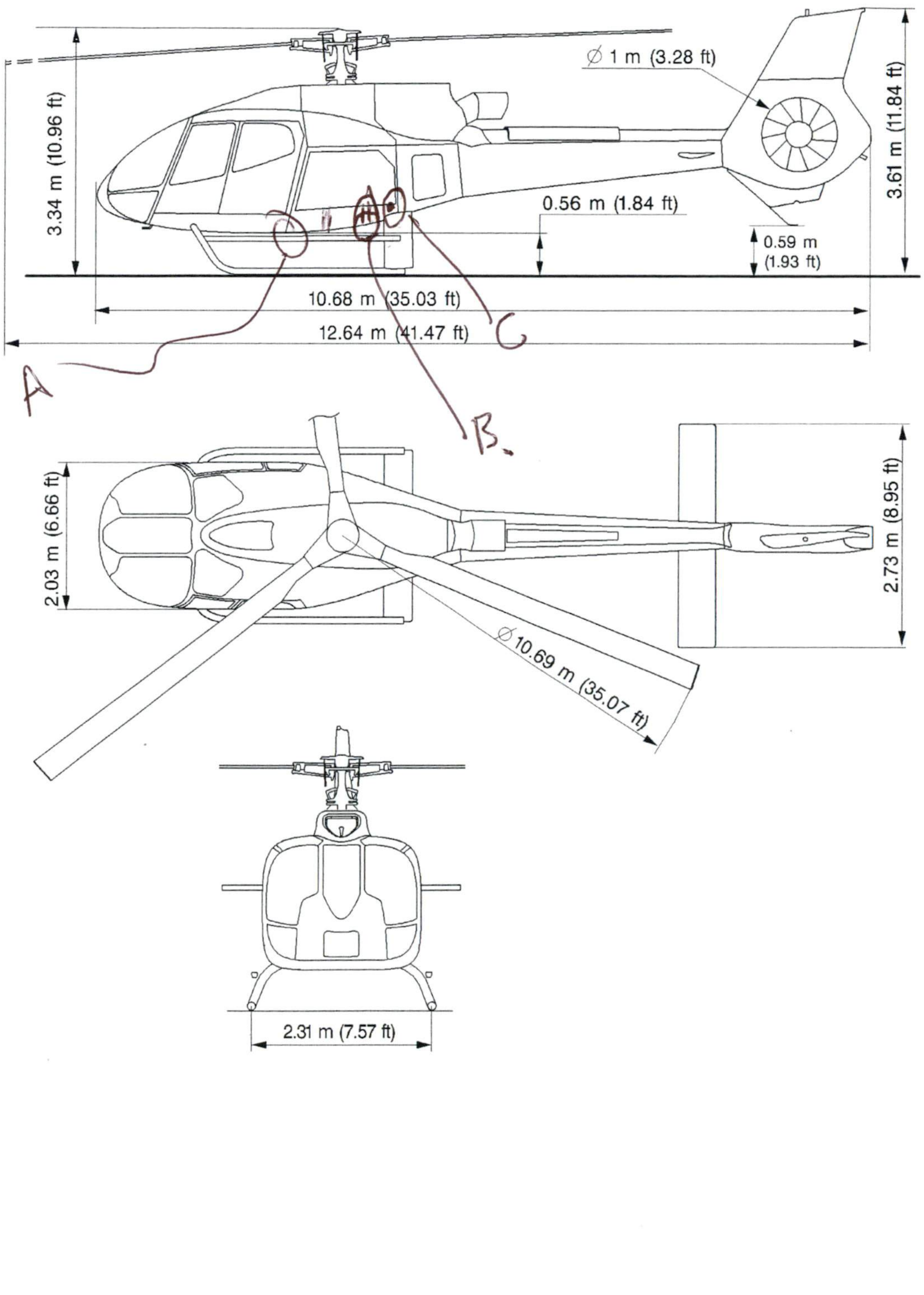


1

LEFT SIDE LOOKING IN.

A

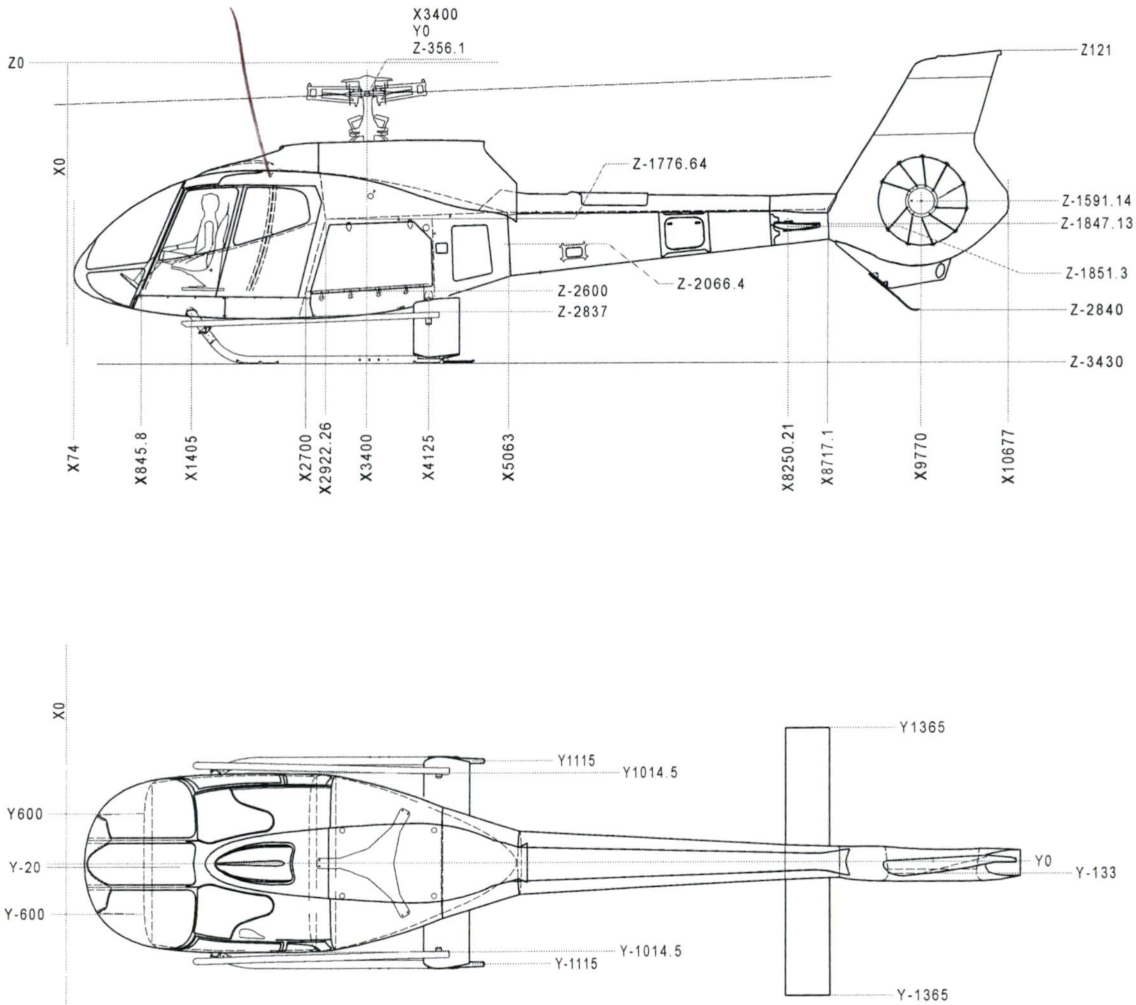
Main dimensions



The data set forth in this document are general in nature and for information purposes only.
For performance data and operating limitations, reference must be made to the approved flight manual and all appropriate documents.

Figure 1. Location of the Main Components of the Structure - Helicopter

Big / Small door
~~Sliding door~~



FRAMEWORK INST, TANKS SUPPORT

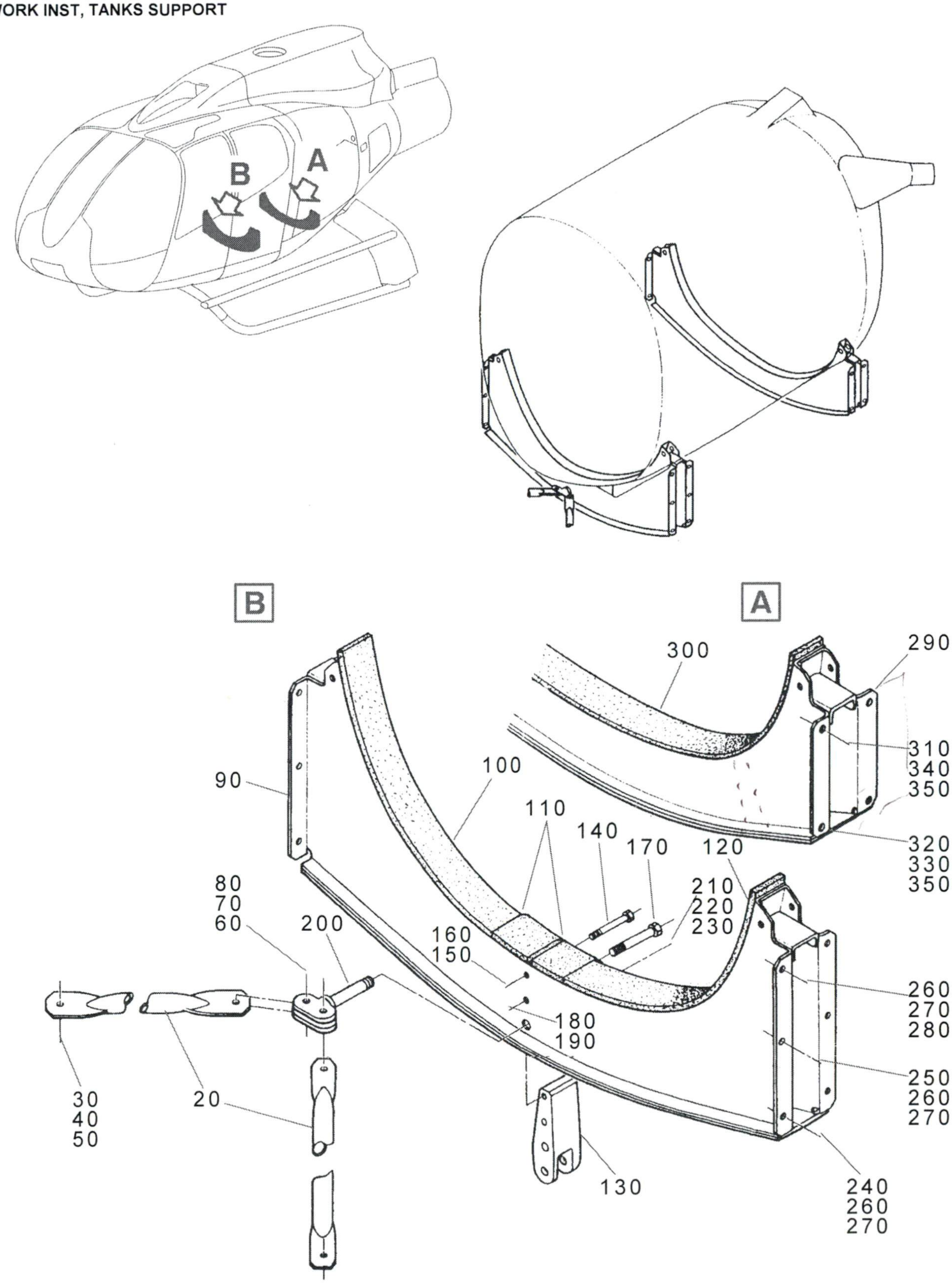


FIG.ITEM	CODE ENT. FSCM	MANUFACTURER PART NUMBER	DESCRIPTION 1234567	QTY ASSY	
03 - 1 For A/C : 3381-3382 3453 3470 3482 3487 3490 3492 3498 3500 3506 3514-3515 3521 3527 3534 3536 3539 3541 3560-3562 3564-3565 3596 3604 3609 3614 3618 3624 3627 3633 3639 3642-3643 3648 3654 3659 3662 3667 3670 3681 3684-3685 3691 3694-3695 3703 3706-3707 3718 3720-3721 3729 3732 3734-3735 3738 3740 3745-3746 3750-3751 3753-3756 3758-3759 3762 3764 3766 3768 3770 3772 3774-3775 3781 3784 3790 3799 3802 3809-3810 3815 3822 3831 3833 3841-3842 3845 3855-3856 3860 3862-3863 3866 3873 3876 3882-3883 3887 3892-3893 3896 3903 3912 3914 3922 3927 3930 3935 3938-3939 3945 3948-3949 3954 3956 3961 3967-3968 3970 3974 3976 3983 3985 3990 3992 3998-3999 4004 4007 4010 4013 4017 4020 4022 4027 4032 4034 4038-4039 4041-4042 4051 4054-4055 4060 4070 4073 4075 4080 4084 4087 4090 4093 4097 4100 4104 4107 4111 4114 4118 4121 4125 4127 4131 4134 4142 4148 4158 4161 4165 4173 4181 4185 4189 4192 4202-4203 4207 4211 4215 4219 4224 4228 4232 4235 4241 4245 4248 4252 4257 4262 4266 4271-4272 4276 4281 4285 4290 4294 4299 4304 4309 4313 4318 4322 4327 4331 4336 4340 4346 4351 4356 4361 4366 4371 4376 4382 4388 4391 4402 4407 4412 4417 4423 4429 4433 4437 4445 4448 4457 4463 4468 4471 4478 4486 4495 4499 4503 4506 4513 4518 4522 4528 4531 4537 4542 4545 4552 4556 4561 4566 4570 4577 4580 4585 4590 4593 4597 4601 4604 4609 4616 4619 4626 4628 4631 4637 4639 4643 4645 4651 4655 4659 4663 4665 4672 4674 4679 4684 4687 4690 4694 4702-4703 4709 4715-4716 4742 4746 4749 4758 4760-4761 4770 4772 4774 4779 4785-4786 4793 4797 4801 4807 4813 4817 4820 4823 4825 4829 4837 4839-4840 4843 4849 4855 4858 4861 4864 4870 4877 4882 4885 4891 4895 4901 4903 4909 4911		+	FRAMEWORK INST, TANKS SUPPORT AFTER AMENDMENT OP 2913	REF	R
20	F0210	350A21-1276-00	. BRACE,STRUT,SLING	2	
30	F0111	22201BC080020L	. SCREW	2	
40	F0111	23118AG080LE	. WASHER	2	
50	F5442	ASN52320BH080N	. NUT	2	
60	F0111	22733BC080010M	. PIN,THREADED	2	
70	F0111	23111AG060LE	. WASHER	2	R
80	F5442	ASN52320BH060N	. NUT	2	
90	F0210	350A21-1062-04	. BEAM ASSY, FRONT	1	
100	F0210	350A21-1388-22	. . STOP,LATERAL	1	
110	F0210	350A21-1388-20	. . STOP,CENTRAL	2	
120	F0210	350A21-1388-21	. . STOP,LATERAL	1	
130	F0210	350A21-1413-00	. FITTING,SLING SUPPORT	1	
140	F0111	22201BC060050L	. . SCREW	1	
150	F0111	23111AG060LE	. . WASHER	1	R
160	F5442	ASN52320BH060N	. . NUT	1	
170	F0111	22201BC080054L	. . SCREW	1	
180	F0111	23111AG080LE	. . WASHER	1	
190	F5442	ASN52320BH080N	. . NUT	1	
200	F0210	350A21-1231-20	. . END,CLEVIS	1	
210	F0111	23121BC120LE	. . WASHER	1	

220	F0111	22451BC100L	. . NUT	1
230	F0111	23310CA020025	. . PIN,SPLIT	1
240	F0111	22201BC080009L	. SCREW	8
250	F0111	22201BC080006L	. SCREW	4
260	F0111	23111AG080LE	. WASHER	24
270	F5442	ASN52320BH080N	. NUT	12
280	F0210	350A13-1114-21	. SHIM	4
290	F0210	350A21-1063-03	. BEAM ASSY, REAR	1
300	F0210	350A21-1233-21	. . ELASTOMER	1
310	F0111	22201BC080110L	. SCREW	4
320	F0111	22201BC080090L	. SCREW	4
330	F0111	23111AG080LE	. WASHER	16
340	F5442	ASN52320BH080N	. NUT	8
350	F0210	350A13-1114-21	. SHIM	4

- ITEM NOT ILLUSTRATED

FAIRING, LOWER REAR, INST.

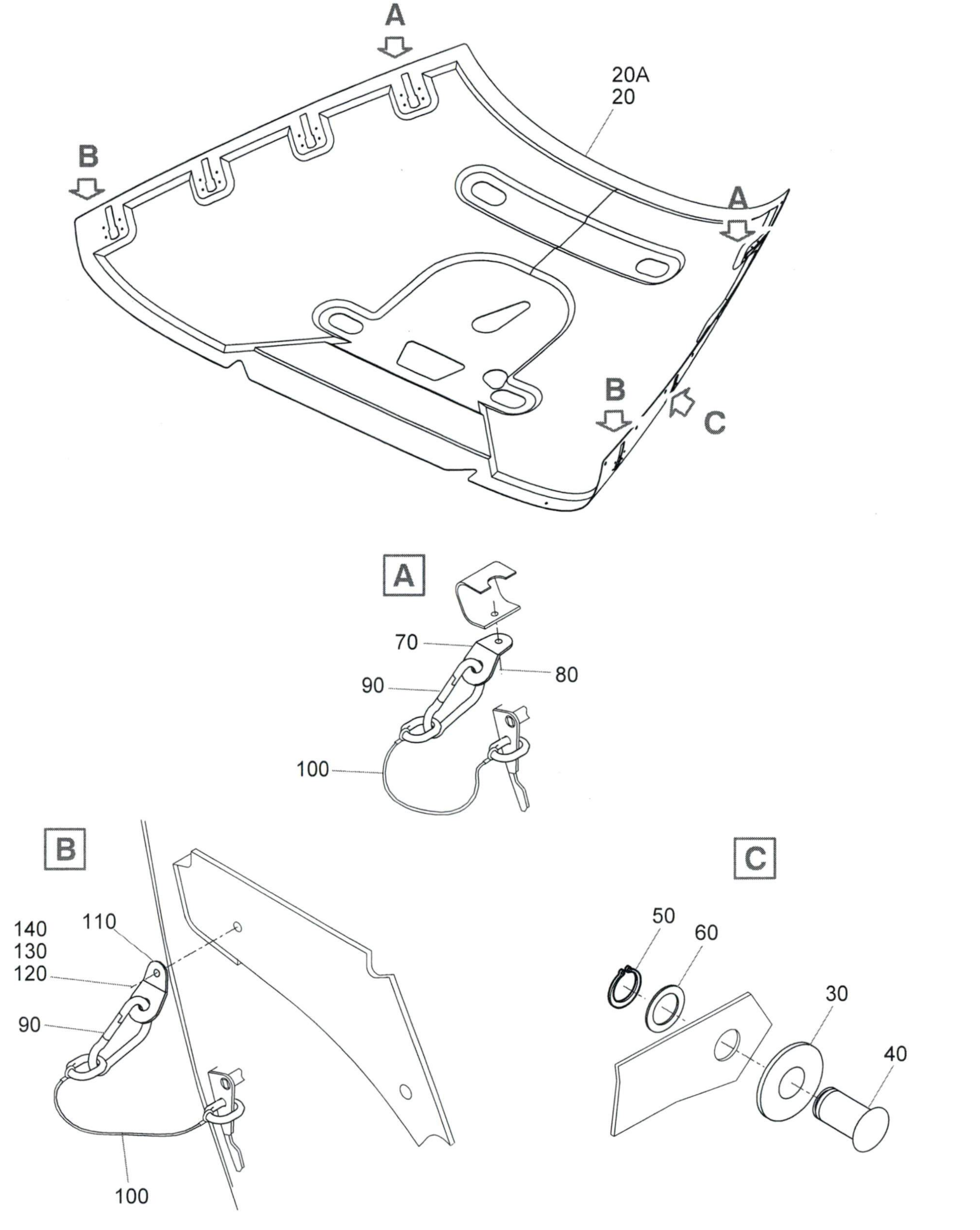
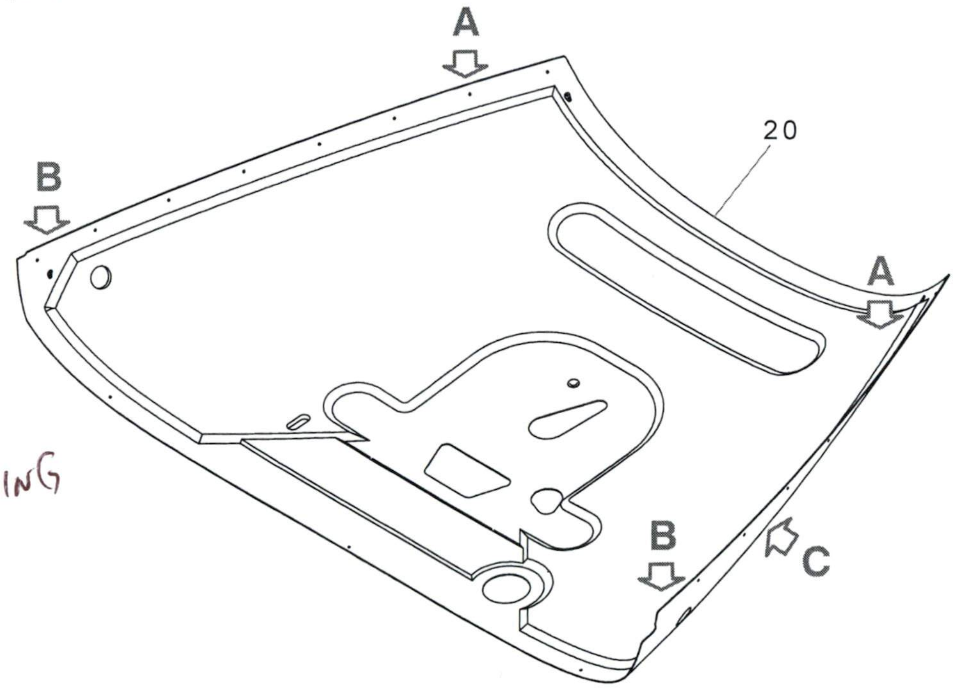


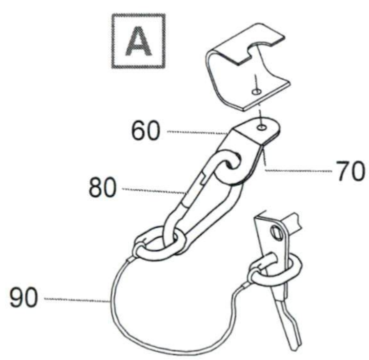
FIG.ITEM	CODE ENT. FSCM	MANUFACTURER PART NUMBER	DESCRIPTION 1234567	QTY ASSY
05 - 1 For A/C : 3358 3363 3381-3382 3453 3470 3482 3487 3490 3492 3498 3500 3506 3514-3515 3521 3527 3534 3536 3539 3541 3560-3562 3564-3565 3596 3604 3609 3614 3618 3624 3627 3633 3639 3642-3643 3648 3654 3659 3662 3667 3670 3681 3684-3685 3691 3694-3695 3703 3774			FAIRING, LOWER REAR, INST. FOR NHA SEE 53-51-20-01-50	REF
05 - 1A For A/C : 3706-3707 3718 3720-3721 3729 3732 3734-3735 3738 3740 3745-3746 3750-3751 3753-3756 3758-3759 3762 3764 3766 3768 3770 3772 3775 3781 3784 3790 3799 3802 3809-3810 3815 3822 3831 3833 3841-3842 3845 3855-3856 3860 3862-3863 3866 3873 3876 3882-3883 3887 3892-3893 3896 3903 3912 3914 3922 3927 3930 3935 3938-3939 3945 3948-3949 3954 3956 3961 3967-3968 3970 3974 3976 3983 3985 3990 3992 3998-3999 4004 4007 4010 4013			FAIRING, LOWER REAR, INST. FOR NHA SEE 53-51-20-01-50A	REF
20	F0210	350A21-0403-00	. FAIRING, LOWER, REAR APPLIC FOR NHA 1	1
20A	F0210	350A21-0403-0003	. FAIRING, LOWER, REAR APPLIC FOR NHA 1A	1
30	F6198	NSA5557-1	. . FAST CLOSING	18
40	F5442	ASNA2857-010	. . PIN	18
50	F5442	ASNA2857C001	. . CIRCLIP	18
60	F6198	ABS0370-01	. . WASHER	18
70	F6198	NSA57304-423ADL	. . TAB,ATTACHING	2
80	F0111	21215DC2406J	. . RIVET	2
90	F0379	4892	. . HOOK,SNAP	4
100	F5442	57303-350	. . CORD,SECURING	4
110	F6198	NSA57304-643ADL	. . TAB,ATTACHING	2
120	F0111	22208BC050010L	. . SCREW	2
130	F0111	23111AG050LE	. . WASHER	2
140	F5442	ASN52320BH050N	. . NUT	2 R

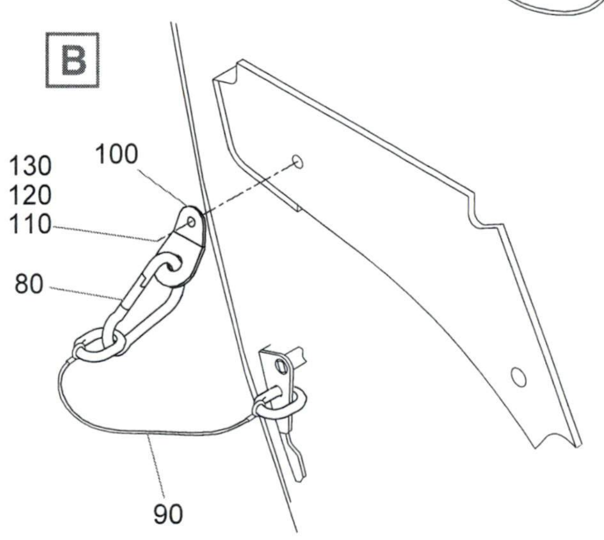
- ITEM NOT ILLUSTRATED

FAIRING, LOWER, REAR, INST.



No CUTOUTS FOR CARGO SWING





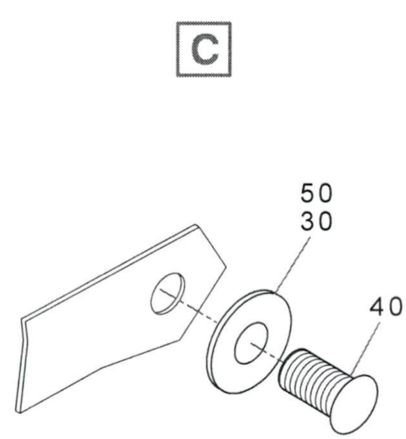


FIG.ITEM	CODE ENT. FSCM	MANUFACTURER PART NUMBER	DESCRIPTION 1234567	QTY ASSY	
09 - 1 For A/C : 4017 4020 4022 4027 4032 4034 4038-4039 4041-4042 4051 4054-4055 4060 4070 4073 4075 4080 4084 4087 4090 4093 4097 4100 4104 4107 4111 4114 4118 4121 4125 4127 4131 4134 4142 4148 4158 4161 4165 4173 4181 4185 4189 4192 4202-4203 4207 4211 4215 4219 4224 4228 4232 4235 4241 4245 4248 4252 4257 4262 4266 4271-4272 4276 4281 4285 4290 4294 4299 4304 4309 4313 4318 4322 4327 4331 4336 4340 4346 4351 4356 4361 4366 4371 4376 4382 4388 4391 4402 4407 4412 4417 4423 4429 4433 4437 4445 4448 4457 4463 4468 4471 4478 4486 4495 4499 4503 4506 4513 4518 4522 4528 4531 4537 4542 4545 4552 4556 4561 4566 4570 4577 4580 4585 4590 4593 4597 4601 4604 4609 4616 4619 4626 4628 4631 4637 4639 4643 4645 4651 4655 4659 4663 4665 4672 4674 4679 4684 4687 4690 4694 4702-4703 4709 4715-4716 4742 4746 4749 4758 4760-4761 4770 4772 4774 4779 4785-4786 4793 4797 4801 4807 4813 4817 4820 4823 4825 4829 4837 4839-4840 4843 4849 4855 4858 4861 4864 4870 4877 4882 4885 4891 4895 4901 4903 4909 4911			FAIRING, LOWER, REAR, INST. FOR NHA SEE 53-51-20-01-50B AFTER AMENDMENT 07 2972	REF	R
20	F0210	350A21-0403-0101	. FAIRING, LOWER, REAR	1	
30	F6198	NSA5557-1	. . FAST CLOSING	18	
40	F5442	A0164TK050S014X	. . SCREW	18	
50	F0111	23116AG050LE	. . WASHER	18	
60	F6198	NSA57304-423ADL	. . TAB,ATTACHING	2	
70	F0111	21215DC2406J	. . RIVET	2	
80	F0379	4892	. . HOOK,SNAP	4	
90	F5442	57303-350	. . CORD,SECURING	4	
100	F6198	NSA57304-643ADL	. . TAB,ATTACHING	2	
110	F0111	22208BC050010L	. . SCREW	2	
120	F0111	23111AG050LE	. . WASHER	2	
130	F5442	ASN52320BH050N	. . NUT	2	R

- ITEM NOT ILLUSTRATED

LOWER FAIRINGS INT.

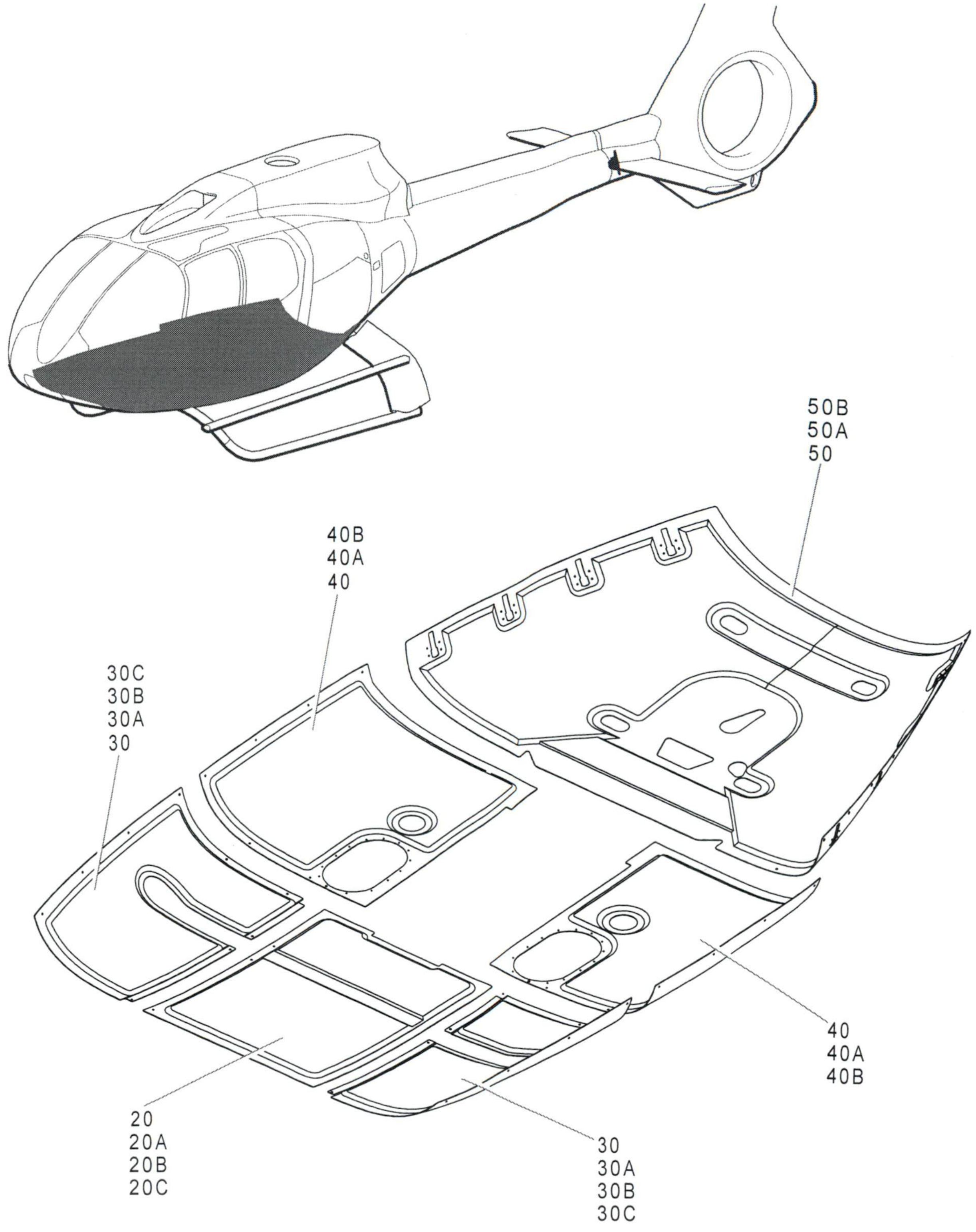
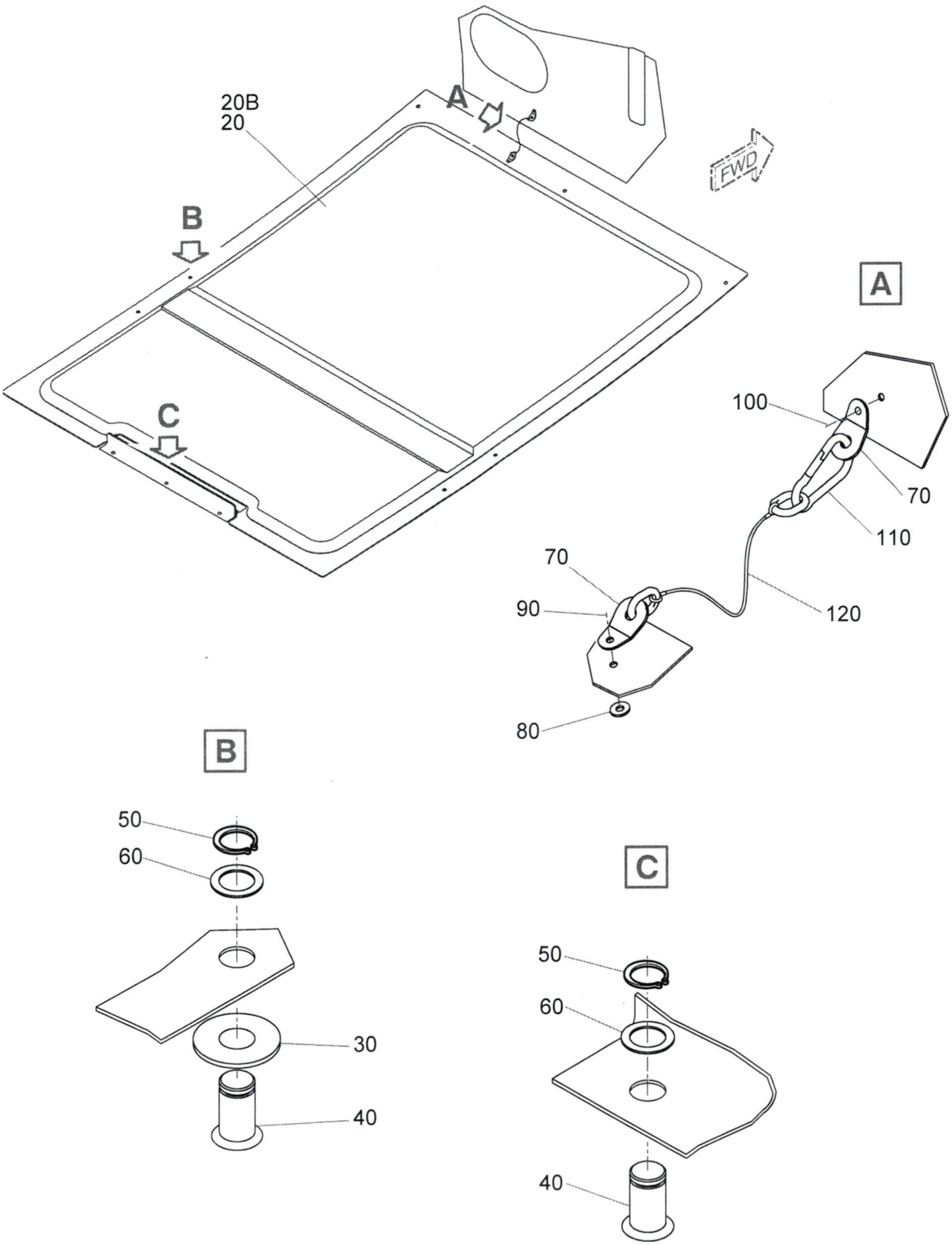


FIG.ITEM	CODE ENT. FSCM	MANUFACTURER PART NUMBER	DESCRIPTION 1234567	QTY ASSY
01 - 1 For A/C : 3358 3363 3381-3382 3453 3470 3482 3487 3490 3492 3498 3500 3506 3514-3515 3521 3527 3534 3536 3539 3541 3560-3562 3564-3565 3596 3604 3609 3614 3618 3624 3627 3633 3639 3642-3643 3648 3654 3659 3662 3667 3670 3681 3685 3691 3694-3695			LOWER FAIRINGS INT. AFTER AMENDMENT 07 2852	REF
01 - 1A For A/C : 3684 3703 3774			LOWER FAIRINGS INST. AFTER AMENDMENT OP 3742	REF
01 - 1B For A/C : 3706-3707 3718 3720-3721 3729 3732 3734-3735 3738 3740 3745-3746 3750-3751 3753-3756 3758-3759 3762 3764 3766 3768 3770 3772 3775 3781 3784 3790 3799 3802 3809-3810 3815 3822 3831 3833 3841-3842 3845 3855-3856 3860 3862-3863 3866 3873 3876 3882-3883 3887 3892-3893 3896 3903 3912 3914 3922 3927 3930 3935 3938-3939 3945 3948-3949 3954 3956 3961 3967-3968 3970 3974 3976 3983 3985 3990 3992 3998-3999 4004 4007 4010 4013			LOWER FAIRINGS INT.	REF
01 - 1C For A/C : 4017 4020 4022 4027 4032 4034 4038-4039 4041-4042 4051 4054-4055 4060 4070 4073 4075 4080 4084 4087 4090 4093 4097 4100 4104 4107 4111 4114 4118 4121 4125 4127 4131 4134 4142 4148 4158 4161 4165 4173 4181 4185 4189 4192 4202-4203 4207 4211 4215 4219 4224 4228 4232 4235 4241 4245 4248 4252 4257 4262 4266 4271-4272 4276 4281 4285 4290 4294 4299 4304 4309 4313 4318 4322 4327 4331 4336 4340 4346 4351 4356 4361 4366 4371 4376 4382 4388 4391 4402 4407 4412 4417 4423 4429 4433 4437 4445 4448 4457 4463 4468 4471 4478 4486 4495 4499 4503 4506 4513 4518 4522 4528 4531 4537 4542 4545 4552 4556 4561 4566 4570 4577 4580 4585 4590 4593 4597 4601 4604 4609 4616 4619 4626 4628 4631 4637 4639 4643 4645 4651 4655 4659 4663 4665 4672 4674 4679 4684 4687 4690 4694 4702-4703 4709 4715-4716 4742 4746 4749 4758 4760-4761 4770 4772 4774 4779 4785-4786 4793 4797 4801 4807 4813 4817 4820 4823 4825 4829 4837 4839-4840 4843 4849 4855 4858 4861 4864 4870 4877 4882 4885 4891 4895 4901 4903 4909 4911			LOWER FAIRINGS INST.	REF R
20			. FAIRING,LOWER, CENTRAL, FRONT, INST. APPLIC FOR NHA 1 FOR DETAIL SEE 53-51-20-02-1	1
20A			. FAIRING,LOWER,CENTRAL,FRONT,INST. APPLIC FOR NHA 1A FOR DETAIL SEE 53-51-20-02-1A	1
20B			. FAIRING,LOWER, CENTRAL, FRONT, INST. APPLIC FOR NHA 1B FOR DETAIL SEE 53-51-20-02-1B	1
20C			. FAIRING, LOWER, CENTRAL, FRONT, INST APPLIC FOR NHA 1C FOR DETAIL SEE 53-51-20-06-1	1
30			. FAIRING, LOWER, FRONT, INST. APPLIC FOR NHA 1 FOR DETAIL SEE 53-51-20-03-1	1
30A			. FAIRING,LOWER,FRONT,INST. APPLIC FOR NHA 1A FOR DETAIL SEE 53-51-20-03-1A	1

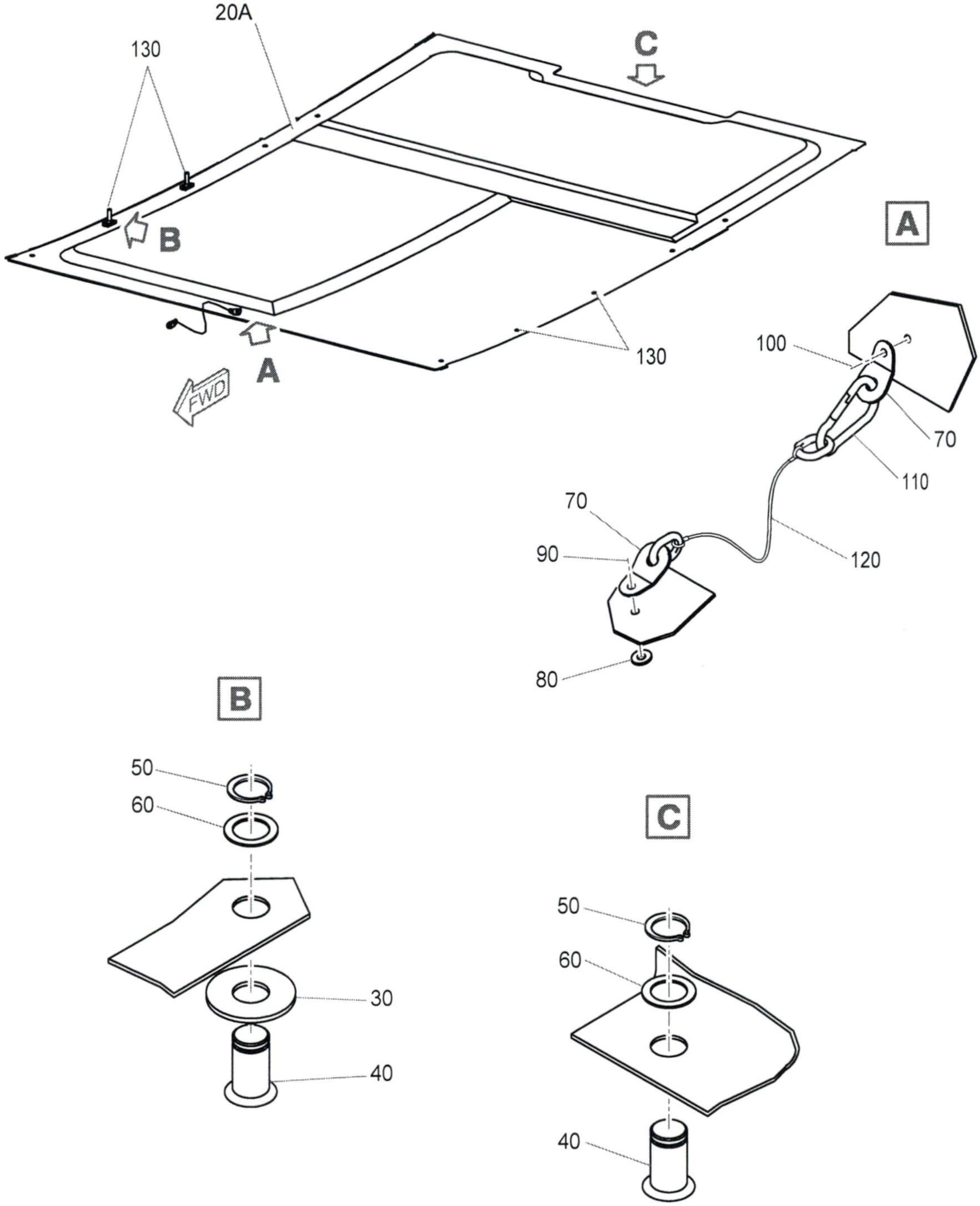
30B	. FAIRING, LOWER, FRONT, INST. APPLIC FOR NHA 1B FOR DETAIL SEE 53-51-20-03-1B	1
30C	. FAIRING, LOWER, FRONT, INST. APPLIC FOR NHA 1C FOR DETAIL SEE 53-51-20-07-1	1
40	. FAIRING, LOWER INTERMEDIATE, INST. APPLIC FOR NHA 1 APPLIC FOR NHA 1A FOR DETAIL SEE 53-51-20-04-1	1
40A	. FAIRING, LOWER INTERMEDIATE, INST. APPLIC FOR NHA 1B FOR DETAIL SEE 53-51-20-04-1A	1
40B	. FAIRING, LOWER, INTERMEDIATE, INST. APPLIC FOR NHA 1C FOR DETAIL SEE 53-51-20-08-1	1
50	. FAIRING, LOWER REAR, INST. APPLIC FOR NHA 1 APPLIC FOR NHA 1A FOR DETAIL SEE 53-51-20-05-1	1
50A	. FAIRING, LOWER REAR, INST. APPLIC FOR NHA 1B FOR DETAIL SEE 53-51-20-05-1A	1
50B	. FAIRING, LOWER, REAR, INST. APPLIC FOR NHA 1C FOR DETAIL SEE 53-51-20-09-1	1

\- ITEM NOT ILLUSTRATED

FAIRING,LOWER, CENTRAL, FRONT, INST.



(Additional sheets:



02)

FIG.ITEM	CODE ENT. FSCM	MANUFACTURER PART NUMBER	DESCRIPTION 1234567	QTY ASSY
02 - 1 For A/C : 3358 3363 3381-3382 3453 3470 3482 3487 3490 3492 3498 3500 3506 3514-3515 3521 3527 3534 3536 3539 3541 3560-3562 3564-3565 3596 3604 3609 3614 3618 3624 3627 3633 3639 3642-3643 3648 3654 3659 3662 3667 3670 3681 3685 3691 3694-3695			FAIRING,LOWER, CENTRAL, FRONT, INST. FOR NHA SEE 53-51-20-01-20	REF
02 - 1A For A/C : 3684 3703 3774			FAIRING,LOWER,CENTRAL,FRONT,INST. FOR NHA SEE 53-51-20-01-20A AFTER AMENDMENT OP 3742	REF
02 - 1B For A/C : 3706-3707 3718 3720-3721 3729 3732 3734-3735 3738 3740 3745-3746 3750-3751 3753-3756 3758-3759 3762 3764 3766 3768 3770 3772 3775 3781 3784 3790 3799 3802 3809-3810 3815 3822 3831 3833 3841-3842 3845 3855-3856 3860 3862-3863 3866 3873 3876 3882-3883 3887 3892-3893 3896 3903 3912 3914 3922 3927 3930 3935 3938-3939 3945 3948-3949 3954 3956 3961 3967-3968 3970 3974 3976 3983 3985 3990 3992 3998-3999 4004 4007 4010 4013			FAIRING,LOWER, CENTRAL, FRONT, INST. FOR NHA SEE 53-51-20-01-20B	REF
20	F0210	350A21-0401-0001	. FAIRING, LOWER FRONT, CENTRAL APPLIC FOR NHA 1	1
20A	F0210	350A08-6249-03	. FAIRING, LOWER FRONT, CENTRAL APPLIC FOR NHA 1A AFTER AMENDMENT OP 3742	1
20B	F0210	350A21-0401-0003	. FAIRING, LOWER FRONT, CENTRAL APPLIC FOR NHA 1B	1
30	F6198	NSA5557-1	. . FAST CLOSING	7
40	F5442	ASNA2857-010	. . PIN	10
50	F5442	ASNA2857C001	. . CIRCLIP	10
60	F6198	ABS0370-01	. . WASHER	10
70	F6198	NSA57304-423ADL	. . TAB,ATTACHING	2
80	F5442	ASNA0113-24CA	. . WASHER	1
90	F5442	ASNA0078E403	. . RIVET	1
100	F0111	21215DC2406J	. . RIVET	1
110	F0379	4892	. . HOOK,SNAP	1
120	F5442	57303-350	. . CORD,SECURING	1
130	F5442	A0164TK050S016X	. SCREW APPLIC FOR NHA 1A	4

- ITEM NOT ILLUSTRATED

9. MODEL EC 130 B4 (Normal Category) Approved June 17, 2002

Canadian Definition	DOT (Canada) Certification List of Mandatory Modifications for DOT Type Definition 350A.05.0027 Revision H dated June 5, 2002.		
Engine	1 Turbomeca Arriel 2B1		
Engine Limits		Generator Speed (Ng)*	Exhaust Gas Temp. (T4) °C (°F)
	Maximum Continuous	97.1%	849 (1560)
	Maximum Take-off (5 min.)	101.1%	915 (1679)
	Maximum Transient	102.3%	865 (10s) (1589)
	Maximum Continuous during starting		750 (1382)
	* 100% = 52,110 RPM		
Rotor Limits		RPM	
	Normal range power on	375 to 405	
	Maximum power off	430*	
	Minimum power off	320**	
	* aural warning greater than or equal to 410 RPM ** aural warning less than or equal to 360 RPM		
Oil Temperature	Minimum for starting (with 3.9 cSt oil)	-50°C (-58°F)	
	Minimum for take-off	-0°C (32°F)	
	Maximum permitted	115°C (230°F)	
Oil Pressure	Minimum	1.1 bars (16 psi)	
	Normal Operating	2.0 to 6.0 bars (29 to 87 psi)	
	Maximum permitted	9.8 bars (142.1 psi)	

MODEL EC 130 B4 (Cont'd)

Transmission Limits		Maximum Torque %	
	Continuous	92.7	
	Take-off	100	
	Transient (5 sec.)	104	
Airspeed Limits (IAS)		Knots	Km/h
	POWER-ON VNE (Never Exceed) sea level	155	287
	POWER-OFF VNE (Never Exceed) sea level	125	231
	See RFM for decrease of these values with altitude and temperature.		
Maximum Weight (Mass)	2,427 kg (5,351 lb.)		
Fuel	Refer to RFM listed in Approved Publications.		
Oil	Refer to RFM listed in Approved Publications for approved engine and gearbox oils.		
Maximum Operating Altitude	23,000 ft. – Pressure Altitude		
Serial Numbers Eligible	S/N 3358 and subsequent		

DATA PERTINENT TO ALL MODELS EXCEPT AS INDICATED

C.G. Limits	See RFM as listed in Approved Publication
Datum	Longitudinal: 3.4 m. (133.8 in.) forward of main rotor hub centre.
Levelling Means	Transmission support platform or mechanical Floor
Minimum Crew	1 pilot
Maximum Occupants	6, including crew
	EC 130 B4 7, (8 with modification OP-3673 installed), including crew

DATA PERTINENT TO ALL MODELS EXCEPT AS INDICATED (Cont'd)

Basis of Certification (Cont'd)

5) EC 130 B4

The following basis of certification has been accepted as equivalent to the Airworthiness Manual Chapter 527 at Change 3 dated January 3, 1994;

a) JAR 27 first issue dated September 6, 1993 with orange paper amendment 27/98/1 effective February 16, 1998.
b) JAA Special Condition on High Intensity Radiated Field.
c) Exemption for rear bench seat regarding JAR 27-562 and JAR 27-785(a),(b),(j) and for fuel systems regarding JAR 27-952(a),(c),(d),(f),(g).
d) Equivalent safety findings on main gearbox oil filter by pass and powerplant instrument markings.
e) Provisions of ICAO Annex 16, Volume I, third edition, amendment 5, chapter 8.
f) Fuel discharge as per ICAO second edition dated July 1993 Annex 16, Volume 2, 2nd part.

6) In addition the following Transport Canada Additional Airworthiness Requirements as published in the Canadian Airworthiness Manual, Chapter 527, change 3 dated January 3, 1994

X a)	527.1093 (b)(1)	Engine Operation in Snow
X b)	527.1301-1	Rotorcraft Operations After Ground Cold Soak
fuel tanks X c)	527.1557(c)(3)	Miscellaneous Markings and Placards
✓ d)	527.1581(e),(f)	Rotorcraft Flight Manual
X e)	527.1583(h)	Operating Limitations, Ambient Temperature

Required Equipment

The basic required equipment as prescribed in the applicable airworthiness requirements (see Basis of Certification) must be installed in the rotorcraft.

AS 350 B, B1, B2, B3, BA, C, D and EC 130 B4

Eurocopter France Report No. 350A.05.0027 lists required and optional equipment.

In addition, the following item of equipment is required:

a) DGAC or EASA Approved Rotorcraft Flight Manual as listed in Approved Publications.

Jeff Clarke

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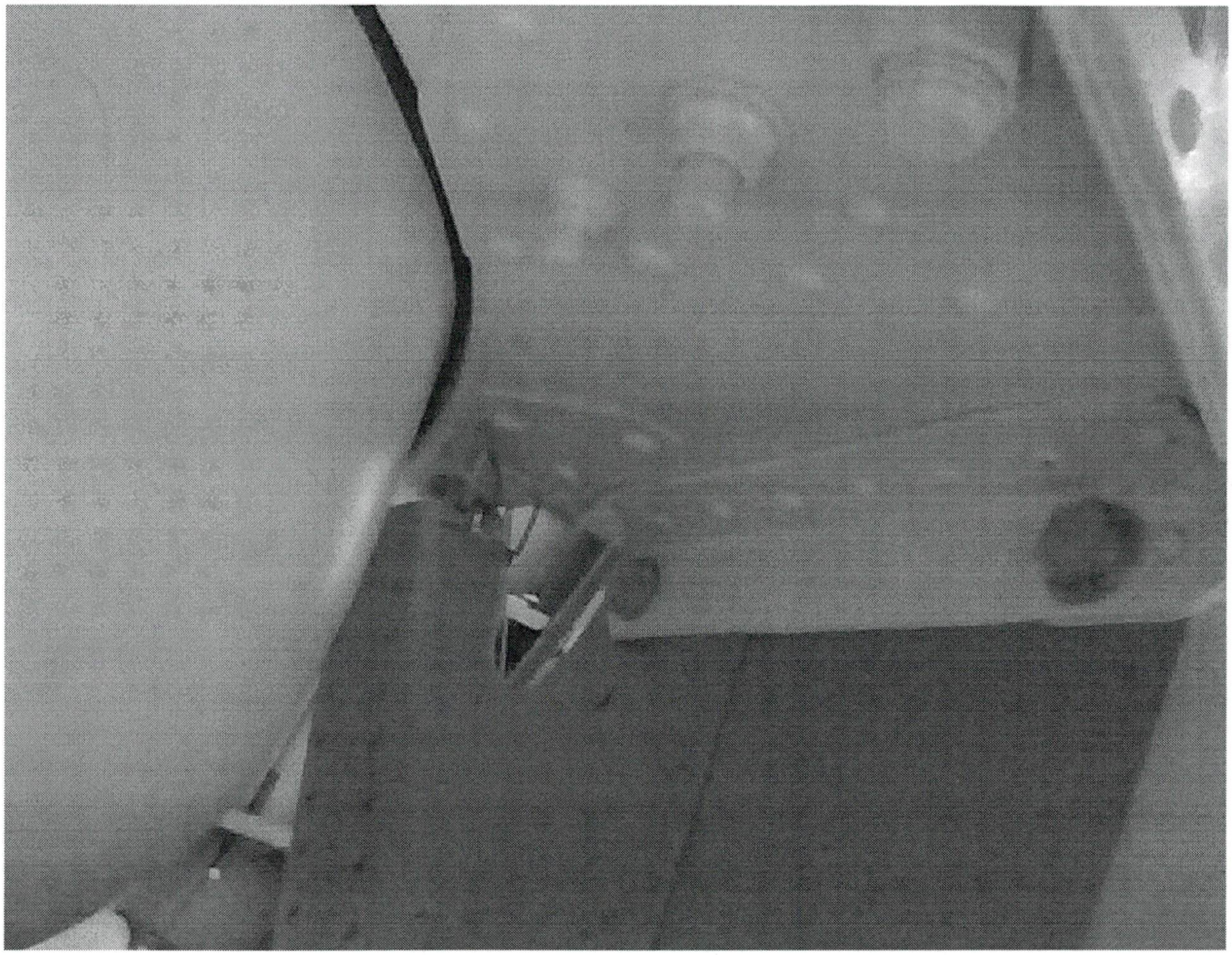

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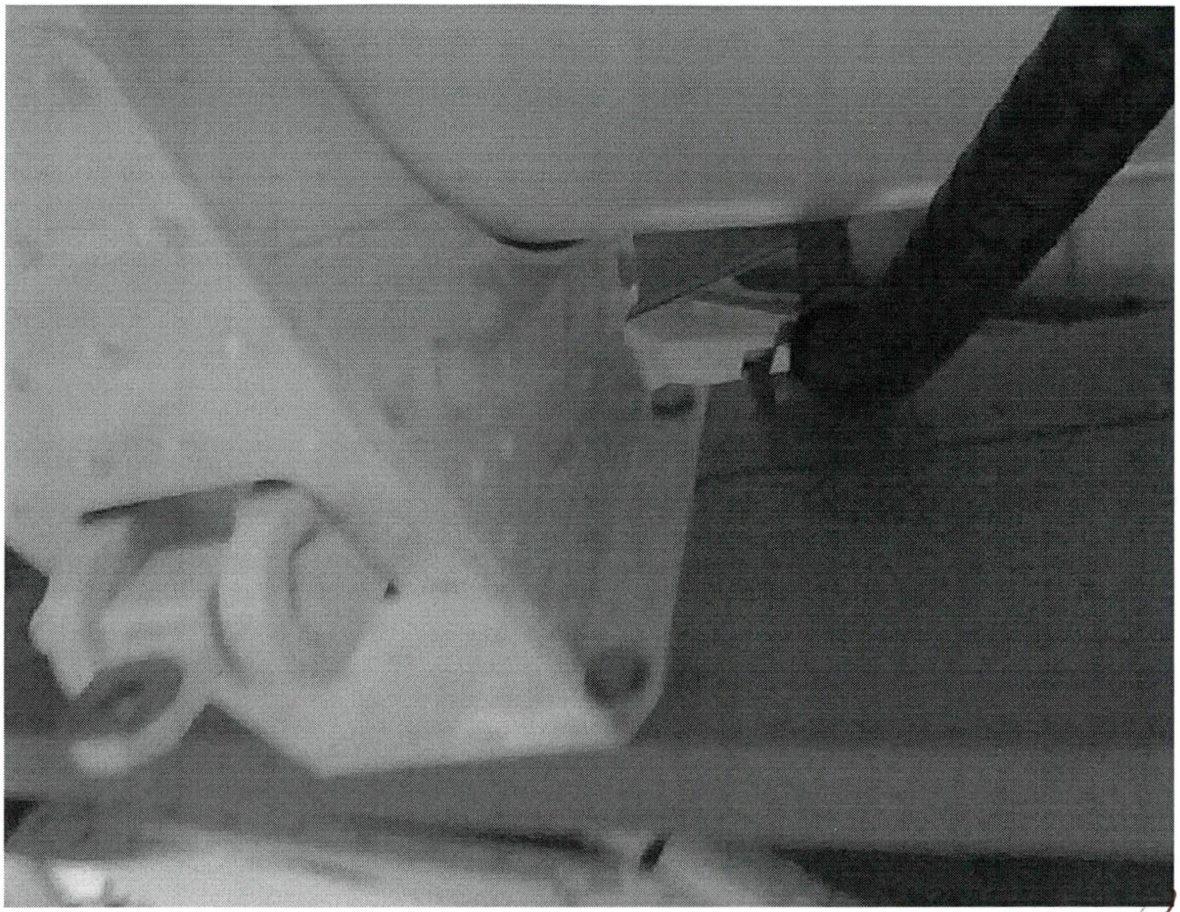
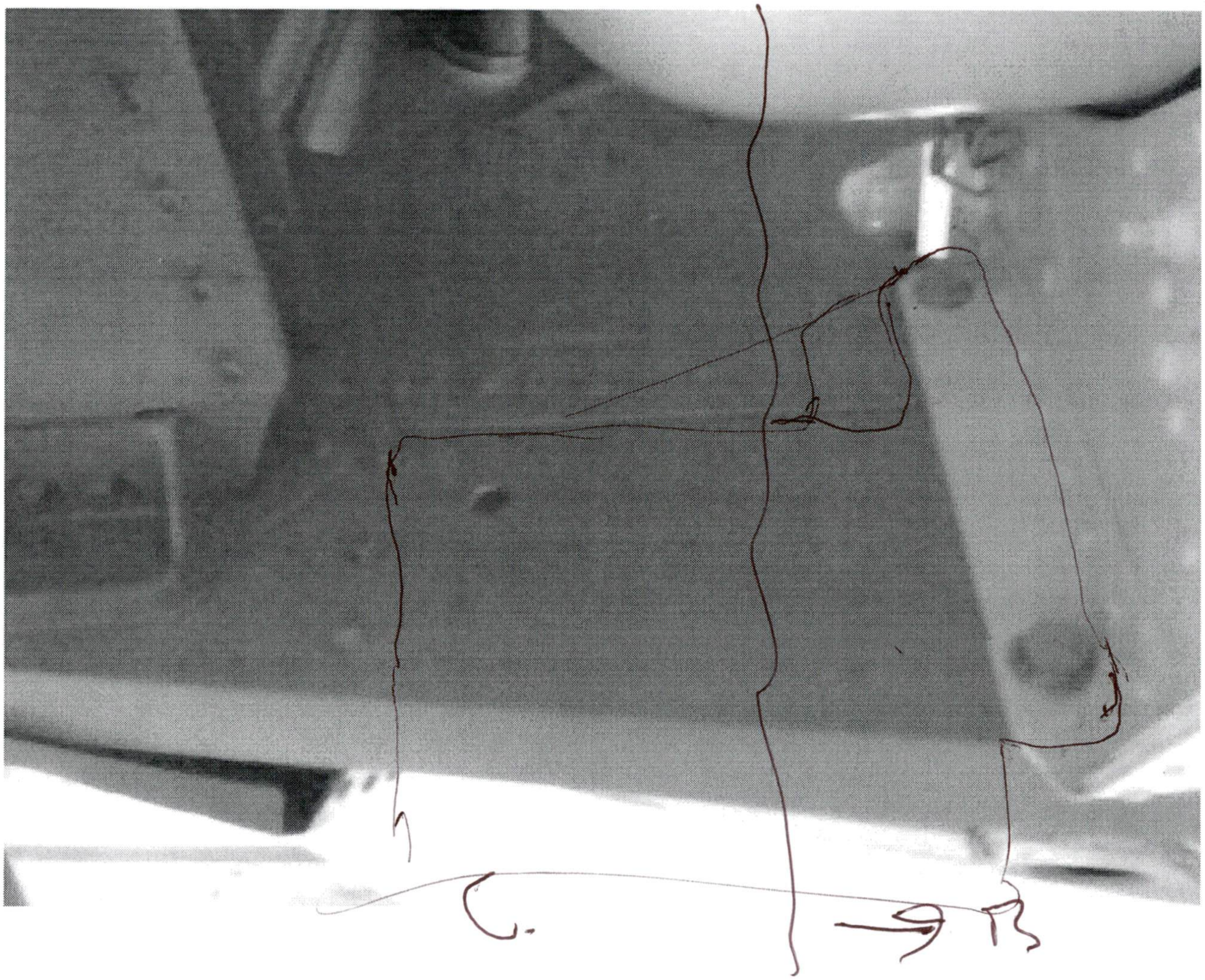


B

AFT TANK SUP'T
LEFT SIDE
LOOK OUTB'D
FORWARD SIDE OF SUP'T



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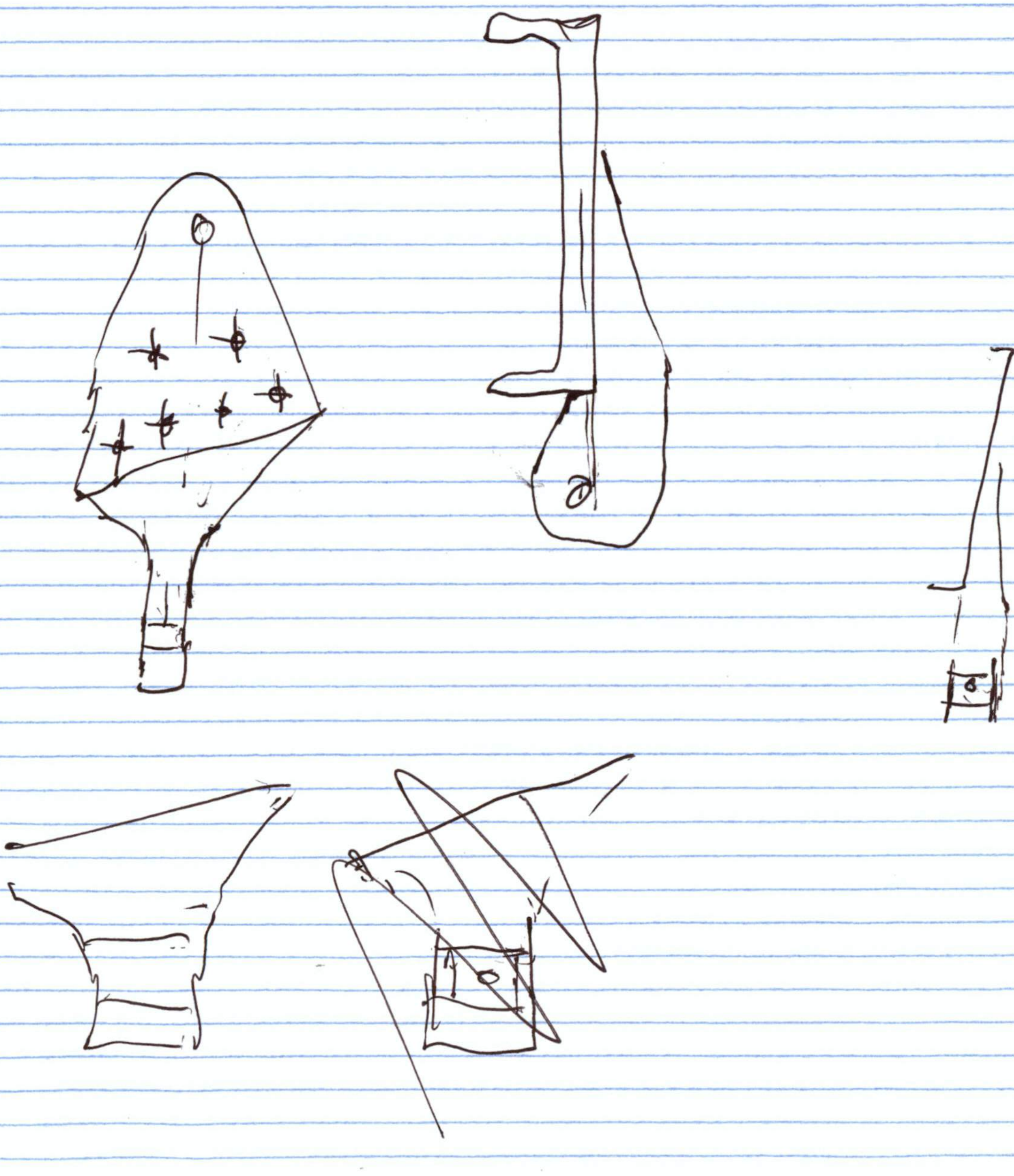
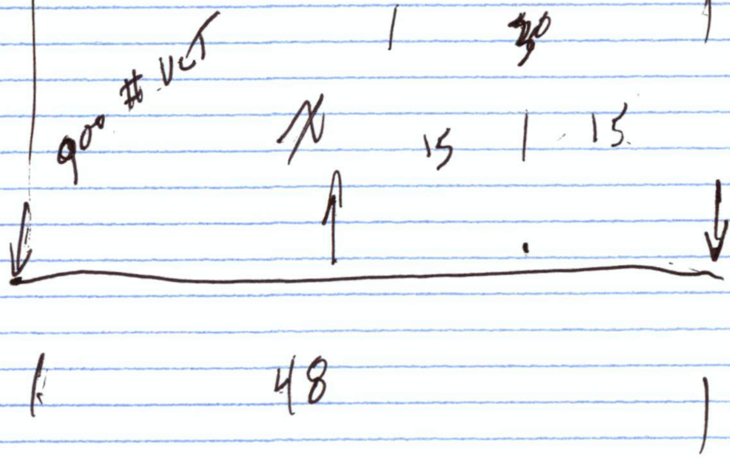
IDEAS



$$\frac{250+75}{2} \cong 165 \times 5.25$$



$$\begin{array}{r} 165 \\ 5.25 \\ \hline 825 \\ 330 \\ 825 \\ \hline 866.25 \end{array}$$

NOTE

5 AD4 Rivets

3 AD5 Rivets

$\cancel{900 \times 48 = x}$

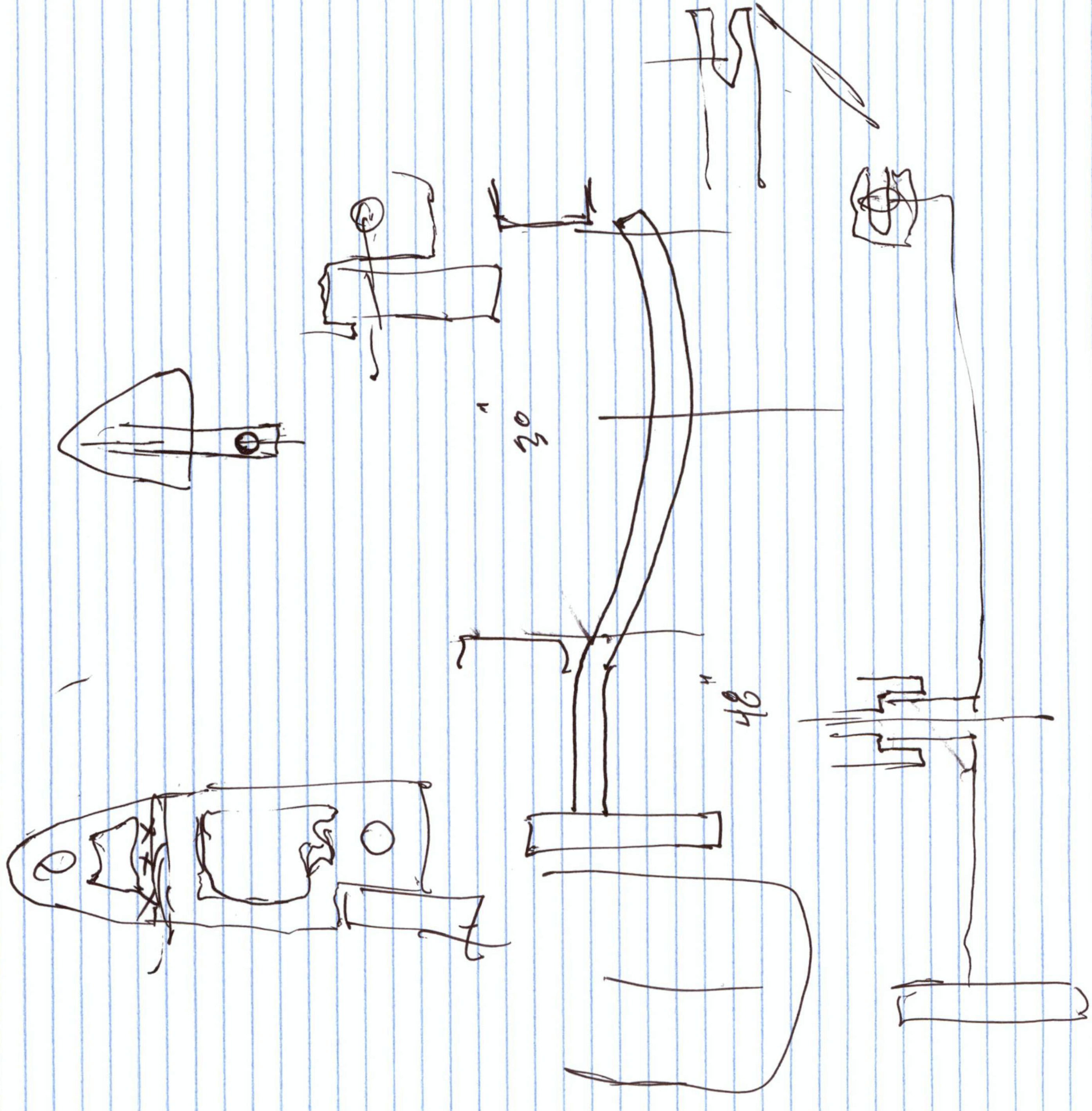
$900\,(48+15) = x\,30$

$$x = \frac{900 \times 63}{30}$$

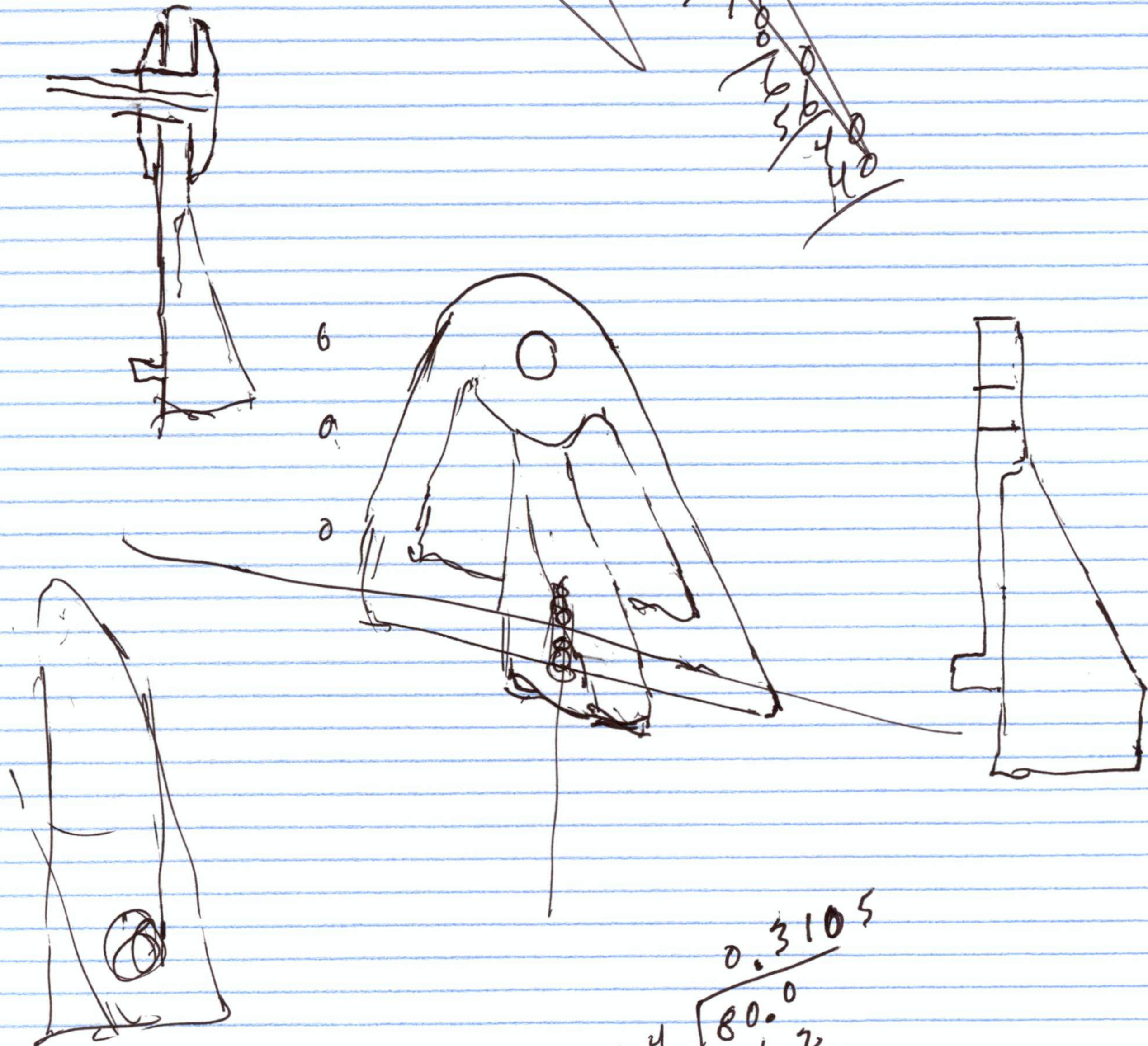
$\cong \underline{\underline{1800 \text{ \# ULT}}}$

$M_{max} = 900_{ULT}\,(48 - 30 + 11)$

$900 \times 30 = 27{,}000$ lb·in

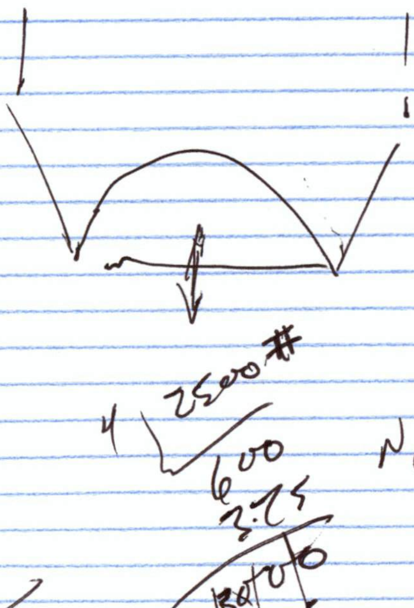

30"
48"

$8\overline{)25.4}$ = 3.175



$25.4\overline{)80.0}$ = 0.3105

8mm = 0.310



CAT 60
SWING

4 2500#

600
3.75 N_{ULT}

3000
4200
1 8.0 1
2250.0 0

HOOK LOAD
2500

7 7.

SPLIT BY 4.

2250 ULT | FTG

1.5^3

$2 \times .75$

1.5
1.5
2.25
1.5
1125
225
3.375
1.5
16875
3375
4.0625

$I =$

$\frac{4.0625}{12}$

.33

$\frac{1}{4}$ ~~5/16~~

$I = \frac{1}{12} bh^3 = \frac{1}{12} \times 1 \times 2^3 = \frac{8}{12} = 0.666$

less $2 \times \frac{1}{12} .75 \times 1.5^3$

$= 0.333$

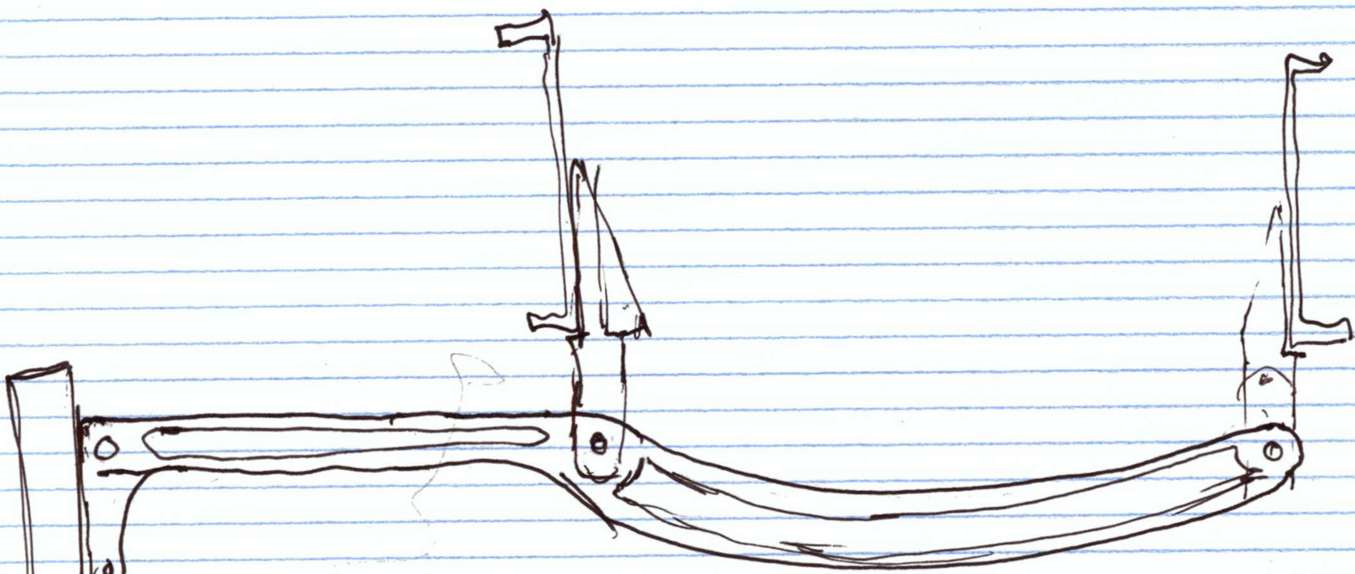
$.333$

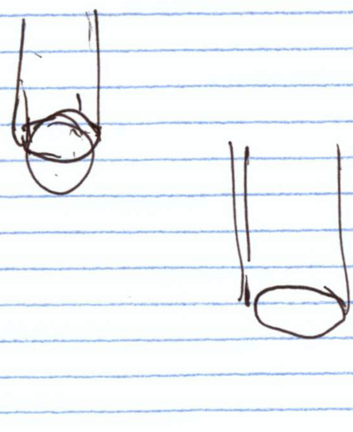
$S = \frac{Mc}{I} =$

$M_{max} = \frac{27000 \times 1}{.333}$

$= 81$ KSI

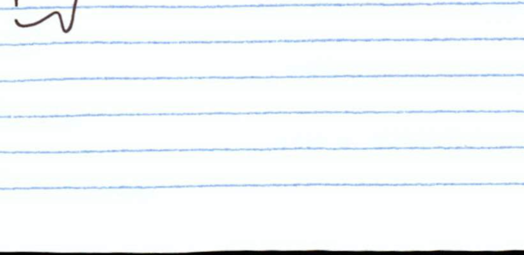
UCL





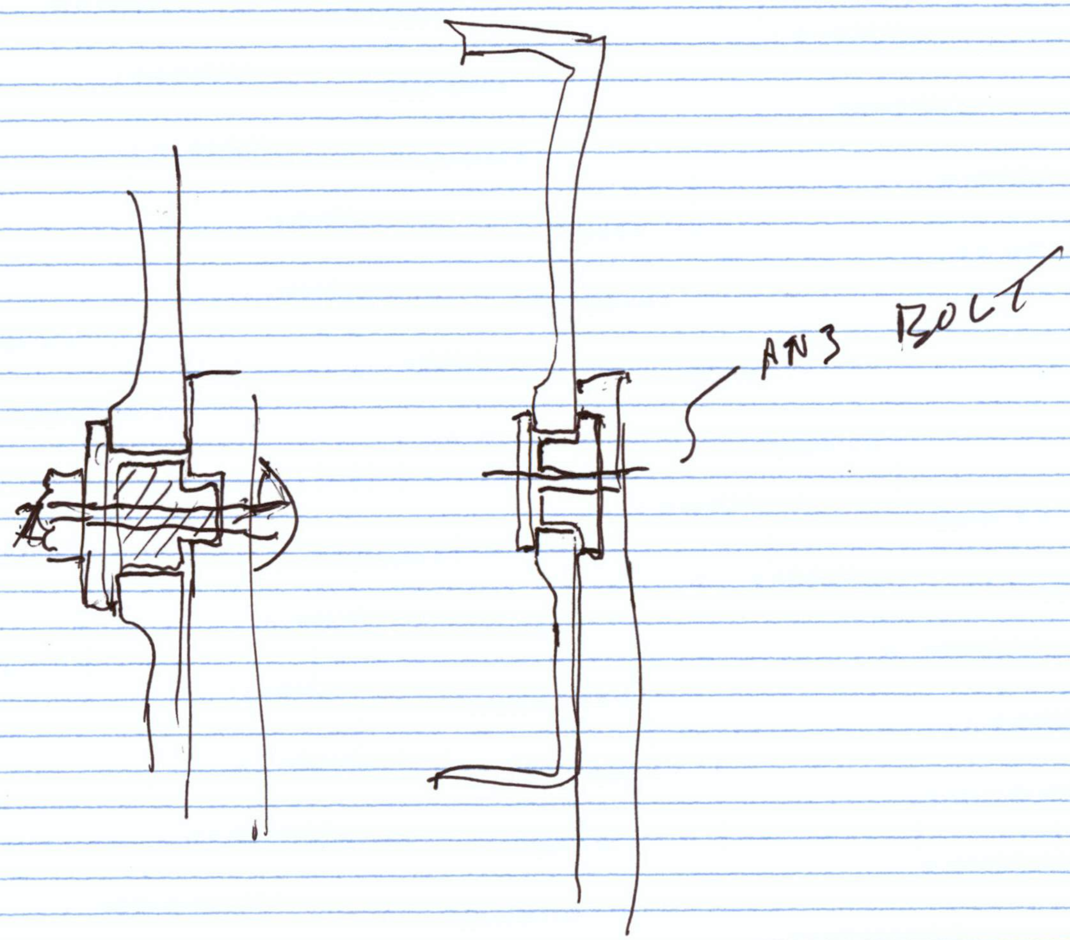
11

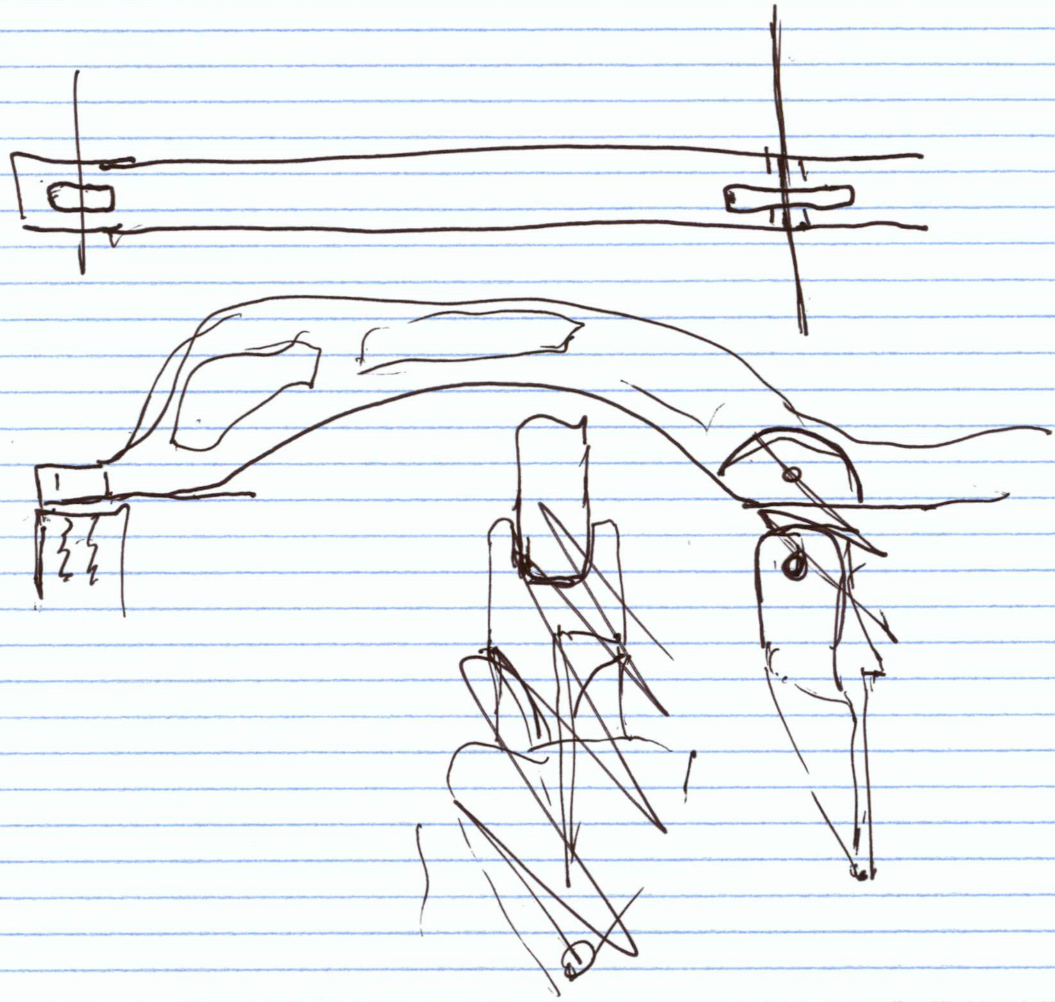
5'

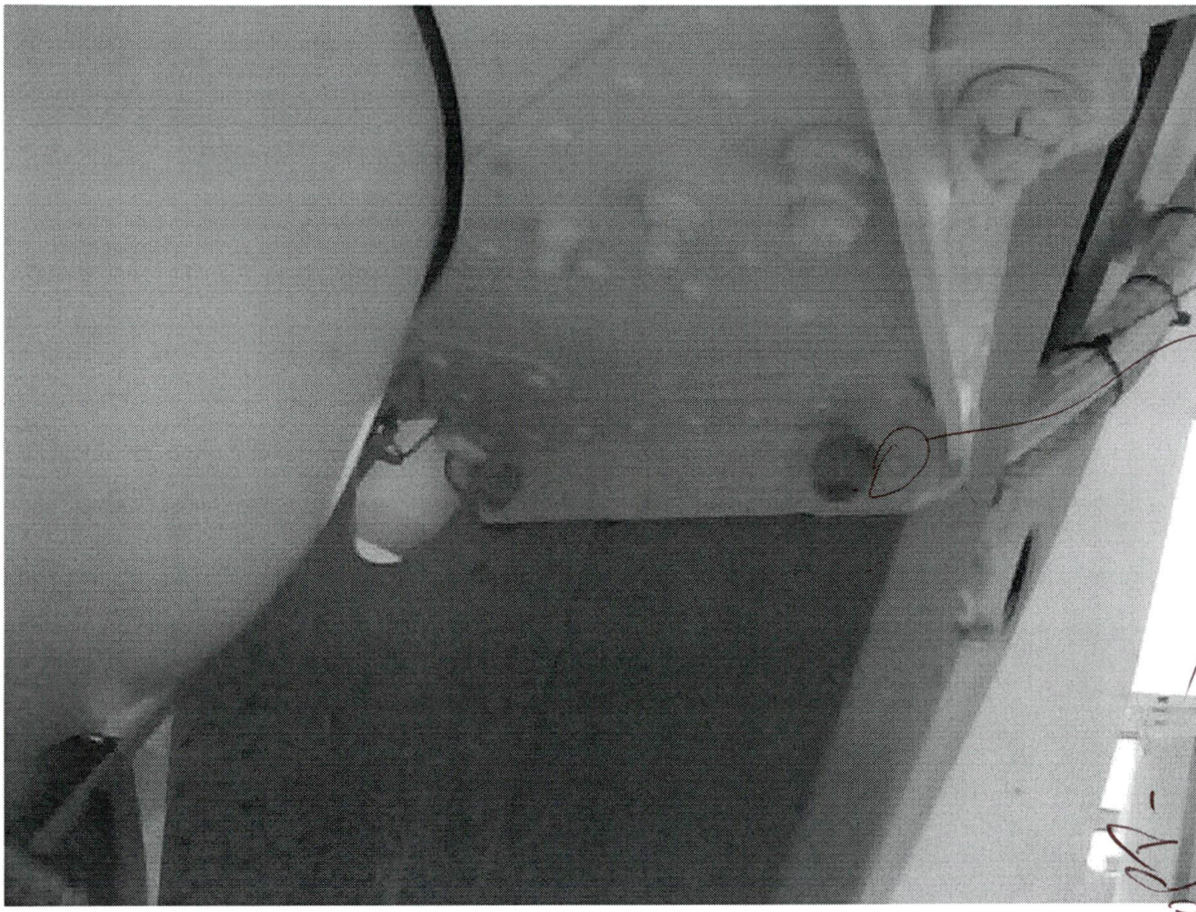


93
6
87

7'3" LONG.


AN3 BOLT





RIVET -

B

#1 TANK SUPT - SIDE OUTBD OF SUPT -
LEFT SIDE
LOOKING AFT

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Jeff Clarke

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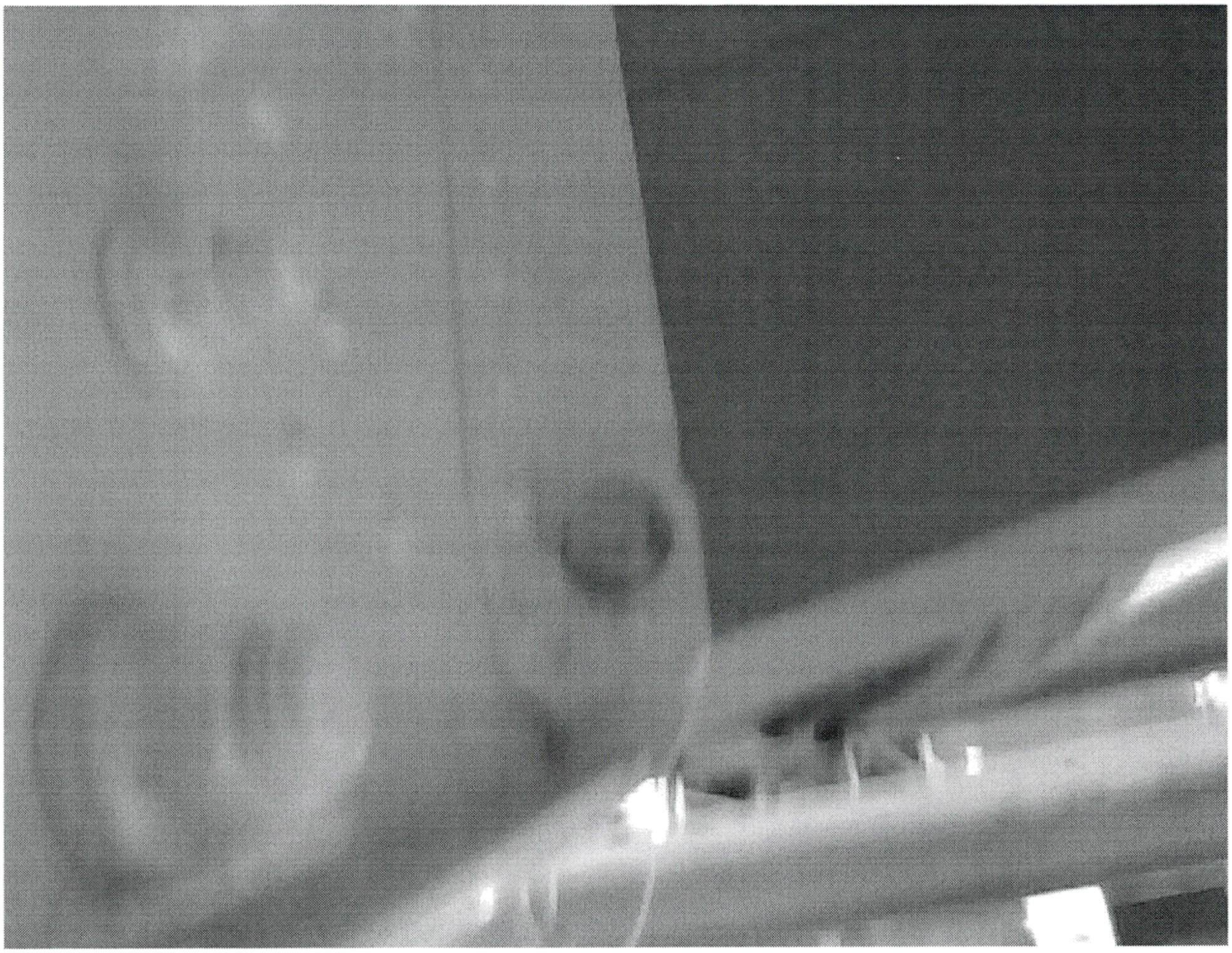

RIGHT SIDE BEAM
LOOKING OUTB'D R.H.

Jeff Clarke

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Sent: July 29, 2010 11:02 AM

To: jeff@aerodesign.ca